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VOL. CXXXIX.—No. 3614] LONDON: FRIDAY EVENING, APRIL 3, 1925 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

PUBLIC NOTICES

TO CONTRACTORS ONLY.

The Commissioners of His Majesty's Works, &c., are prepared to receive separate TENDERS before 11 a.m., on Friday, 24th April, 1925, for the SUPPLY of MECHANICAL and ELECTRICAL ENGINEERING LABOUR during the period of three years in the following districts—

Leeds,
Newcastle-on-Tyne,
Southampton.

Forms for Tender, &c., may be obtained from the CONTRACTS BRANCH, H.M. Office of Works, King Charles-street, London, S.W. 1. 8840

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1. invites TENDERS for—

STEEL POLES for ELECTRICAL TRANSMISSIONS.

Tenders due on the 21st April, 1925.
Tender forms obtainable from above. 8845

Northampton Polytechnic INSTITUTE,
ST. JOHN-STREET, CLERKENWELL, E.C. 1.

ENGINEERING DAY COLLEGE.

ENTRANCE EXAMINATIONS, SESSION 1925-26.

ENTRANCE EXAMINATIONS in connection with the ENGINEERING DAY COLLEGE of the above Institute will be held as follows :—

TUESDAY and WEDNESDAY, April 21st and 22nd.
TUESDAY and WEDNESDAY, SEPTEMBER 22nd and 23rd.

Each examination provides for admission at the commencement of the Autumn Term, 1925, the April examination being specially designed to meet the convenience of intending students who desire to ascertain in advance their position in regard to admission.

Further information may be had on application to 8801 THE PRINCIPAL.

University of Liverpool.

SESSION 1925-1926.

FACULTY OF ENGINEERING.

DEAN: Professor C. O. BANNISTER, M. Eng., Assoc. R.S.M., F.I.C., M. Inst. M.M.

Prospectus and full particulars may be obtained on application to the REGISTRAR of Courses designed for Students desiring to qualify as Mechanical, Electrical, Civil, or Marine Engineers, as Naval Architects, or as Metallurgists and Metallurgical Engineers. 8816

Huddersfield Education Committee.

HUDDERSFIELD TECHNICAL COLLEGE.
PRINCIPAL: J. F. HUDSON, M.A., B.Sc.

APPLICATIONS are INVITED for the POSITION of DEMONSTRATOR in the Department of Mechanical Engineering. Applicants must be specially qualified to Take Charge of the Advanced Mechanical Engineering Laboratories. Graduate preferred.

Salary in accordance with the Burnham Arbitration Award.

Statement of duties and forms of application may be obtained on receipt of a stamped addressed envelope, and must be returned not later than Saturday, 18th April, 1925.

L. G. THORNBER,
Director of Education.

Education Offices,
Huddersfield. 8846

Bilston Urban District Council.

NEW BRATCH WATER SCHEME.
CONTRACT No. 2.
CAST IRON PIPES.

The Council are prepared to receive TENDERS from experienced Pipe Founders for the SUPPLY and DELIVERY of about 1400 Tons of CAST IRON PIPES and SPECIALS of 16in., 12in., 6in., 5in., and 4in. diameters, manufactured in accordance with the British Standard Specification.

The specification and form of Tender, prepared by Dr. H. Lapworth, M. Inst. C.E., 15, Victoria-street, Westminster, S.W. 1, Engineer, may be obtained from the UNDERSIGNED upon payment of a deposit of £2. The amount of the deposit will be returned only after the receipt of a bona fide Tender by the date specified and the return of the specification.

Sealed Tenders, marked "Contract No. 2, Tender for Cast Iron Pipes," and addressed to the UNDERSIGNED, must be delivered not later than 10 a.m. on the Sixteenth of April, 1925.

The Council do not bind themselves to accept the lowest or any Tender.

JOSEPH L. ARLIDGE,
Clerk and Solicitor of the Council.

Town Hall, Bilston,
April 1st, 1925. 8797

Metropolitan Asylums Board.

TO ENGINEERS.

The Board invite separate TENDERS for :—

(a) GENERAL ENGINEERING WORK, including Steam Plant, Steam and Condense Mains, Heating and H.W.S. Mains, and apparatus, Electric Motor Drives for Deep Well Engines and Laundry, &c.
(b) INSTALLATION of FOUR NEW LANCASHIRE STEAM BOILERS.
(c) INSTALLATION of NEW FUEL ECONOMISER.
(d) BUILDING BRICKWORK SETTINGS for Four Boilers and Fuel Economiser.
(e) INSTALLATION of NEW LAUNDRY MACHINERY and PLANT.
(f) INSTALLATION of ELECTRICAL GENERATING PLANT, Motors and Power Wiring.

At the Leavesden Mental Hospital, King's Langley, Herts.

Each in accordance with the specification and drawings prepared by Mr. T. Cooper, M. Inst. C.E., M.I. Mech. E., Engineer-in-Chief. The specifications, drawings, and forms of Tender may be inspected at the Office of the Board, Victoria Embankment, E.C. 4, on and after 10 a.m. on Monday, 6th April, 1925, and can then be obtained upon payment of a deposit of £1 in respect of each work. The amount of the deposit will be returned only after the receipt of a bona fide Tender sent in accordance with the instructions on the form of Tender, and after the specification and the drawings have been returned.

Tenders, addressed as noted on the form, must be delivered at the Office of the Board not later than 2.30 p.m. on Monday, 27th April, 1925. In the case of (a) and the others (b) to (f) not later than 2.30 p.m. Wednesday, 22nd April, 1925.

C. A. POWELL,
Clerk to the Board.

8824

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.

A New Iron Foundry at a Sheffield Works.

The British Steam Railway Locomotive from 1825 to 1924—No. 14.

The Institution of Naval Architects.

Apprenticeship in the Royal Ordnance Factories.

Canal-Water Softening Plant.

A War Office Subsidy 2-Ton Chassis.

Hardening and Carburising Plant at a Motor Works.

New Rotary Converters in Liverpool Substations.

PUBLIC NOTICES

County Borough of Brighton.

WATERWORKS DEPARTMENT.
SHOREHAM PUMPING STATION.

The Corporation invite TENDERS for the CONSTRUCTION of a REINFORCED CONCRETE ROOF over the Receptacle at the above Pumping Station in Steyning-road, Old Shoreham.

Drawings may be seen and specification, bills of quantities and form of Tender obtained from Mr. A. B. Cathcart, M. Inst. C.E., Waterworks Engineer, 12, Bond-street, Brighton, upon payment of a deposit of Two Guineas, which will be refunded upon receipt of a bona fide Tender (not subsequently withdrawn), together with the documents supplied.

Sealed Tenders, endorsed "Tender for Roof over Receptacle, Shoreham Works," must be delivered at my office, Town Hall, Brighton, not later than Noon on Tuesday, 21st April, 1925.

The Corporation do not bind themselves to accept the lowest or any Tender.

JAS. H. ROTHWELL,
Town Clerk.

Town Hall, Brighton,
25th March, 1925. 8784

County Borough of Brighton.

WATERWORKS DEPARTMENT.
DITCHLING-ROAD SERVICE RESERVOIR.

The Corporation invite TENDERS for the ERECTION and COMPLETION of a REINFORCED CONCRETE SERVICE RESERVOIR of 1¼ million gallons capacity in Ditchling-road, Brighton.

Drawings may be seen and specification, bills of quantities and form of Tender obtained from Mr. A. B. Cathcart, M. Inst. C.E., Waterworks Engineer, 12, Bond-street, Brighton, upon payment of a deposit of Two Guineas, returnable upon receipt of a bona fide Tender (not subsequently withdrawn), together with the documents supplied.

Sealed Tenders, endorsed "Tender for Ditchling-road Reservoir," must be delivered at my office, Town Hall, Brighton, not later than Noon on Tuesday, 21st April, 1925.

The Corporation do not bind themselves to accept the lowest or any Tender.

JAS. H. ROTHWELL,
Town Clerk.

Town Hall, Brighton,
25th March, 1925. 8785

County Borough of Salford.

ELECTRICITY DEPARTMENT.
FREDERICK-ROAD POWER STATION.

PLANT FOR DISPOSAL.

ONE Weir TURBINE FEED PUMP, 15,000 galls capacity per hour.
TWO Weir TURBINE FEED PUMPS, 12,500 galls. capacity per hour, suitable for steam pressure of 200 lb. per square inch.
TWO Electrically Driven 3-plunger FEED PUMPS, 4000 gallons capacity per hour each. D.C. motors 440 and 220 volts.
TWO SETS of Lea RECORDING INSTRUMENTS and tanks complete.
TWO Weir CONTACT-EXHAUST HEATERS.
TWO Royles' EXHAUST STEAM HEATERS.
STEEL STEAM PIPING, 14in. bore to 6in. bore.
Hopkinson-Ferranti STOP VALVES, 14in. to 6in. bore, all suitable for 200 lb. steam pressure.
CAST IRON VALVES, 4in. bore for boiler-feed piping and other purposes.
CAST IRON BOILER FEED PIPING, 4in. bore.
Also approximately 180ft. of Circulating WATER PIPING, 26in. and 24in. bore with 24in. back pressure valve to suit, and various lengths of Discharge Piping, 34in., 28in., and 22in. bore.

Full particulars and form of Tender may be obtained on application to the Borough Electrical Engineer, Electricity Works, Frederick-road, Salford.

Offers to be received not later than first post on Thursday, the 16th proximo.

L. C. EVANS, Town Clerk.

30th March, 1925. 8832

PUBLIC NOTICES

Rochester and Chatham Joint SEWERAGE BOARD.
OUTFALL SEWER.
CONTRACT No. 2.

The Board is prepared to receive TENDERS for the CONSTRUCTION of about—

345 Yards Lin., 42in. diameter, CONCRETE SEWER CULVERT.
138 Yards Lin., 39in. diameter, CONCRETE SEWER CULVERT.
1176 Yards Lin., 36in. diameter, CONCRETE SEWER CULVERT.
1184 Yards Lin., 30in. diameter, CONCRETE SEWER CULVERT.

and 1136 Yards Lin. LAYING and JOINTING 30in. diameter CAST IRON PIPES, 2230 yards of these lengths being in tunnel, together with deep Manholes and other Appurtenant Works.

The works are part of the Board's scheme of sewerage, which is approved for grant by the Unemployment Grants Committee, and that Committee has laid down as a condition that all contracts for or incidental to the works are to be placed in this country.

The Board will require that all goods and materials supplied shall be of British production and manufacture.

Plans may be seen, and quantities and form of Tender, specification and conditions of contract obtained, at the office of the Engineers, Messrs. W. H. Radford and Son, Chartered Civil Engineers, Albion Chambers, King-street, Nottingham, and also at my office, as under, on deposit of Five Guineas (cheque), which will be returned on receipt of a bona fide Tender and the return of the quantities.

The lowest or any Tender will not necessarily be accepted.

Sealed Tenders to be delivered to me at my office, as under, on or before Thursday, the 30th April, 1925, endorsed "Contract No. 2, Joint Sewer."

By Order,
EDWARD B. LEE,
Clerk to the Board.

Town Hall,
Chatham, Kent,
26th March, 1925. 8793

Rochester and Chatham Joint SEWERAGE BOARD.
OUTFALL SEWER.—CONTRACT No. 3.
TO IRONFOUNDERS.

The Board is prepared to receive TENDERS direct from Ironfounders for the SUPPLY and DELIVERY at Chatham, Kent, of about 500 Tons of CAST IRON PIPES and SPECIAL CASTINGS.

The pipes and special castings will be mostly 30in. diameter, and small quantities of 24in., 18in., 12in., 9in., and 7in.; also a number of Manhole Covers, &c.

The pipes and castings are required in connection with the Board's scheme of sewerage, which is approved for grant by the Unemployment Grants Committee, and that Committee has laid down as a condition that all contracts for or incidental to the works are to be placed in this country.

The Board will require that all goods shall be of British production and manufacture.

Quantities and form of Tender, specification and conditions of contract may be obtained from the office of the Engineers, Messrs. W. H. Radford and Son, Chartered Civil Engineers, Albion Chambers, King-street, Nottingham, on a deposit of Two Guineas (cheque), which sum will be returned on receipt of a bona fide Tender and the return of the quantities, &c.

The lowest or any Tender will not necessarily be accepted.

Sealed Tenders to be delivered to me at my office, as under, on or before Thursday, the 30th April, 1925, endorsed "Ironwork Contract."

By Order,
EDWARD B. LEE,
Clerk to the Board.

Town Hall,
Chatham, Kent,
26th March, 1925 8794

PUBLIC NOTICES

Borough of Chatham.

INTERNAL SEWERS, CONTRACT No. 1.

The Corporation is prepared to receive TENDERS for the CONSTRUCTION of about—

330 Yards Lin., 18in. diam., IRON PIPE SEWERS.
1,927 Yards Lin., 18in. diam., STONEWARE PIPE SEWERS.
150 Yards Lin., 15in. diam., STONEWARE PIPE SEWERS.
2,340 Yards Lin., 12in. diam., STONEWARE PIPE SEWERS.
12,960 Yards Lin., 9in. diam., STONEWARE PIPE SEWERS.
10,140 Yards Lin., 7in. diam., STONEWARE PIPE SEWERS.

Together with Manholes and other Appurtenant Works in the High Level Area of the Borough of Chatham.

As the works the subject of this contract are works in respect of which grants are to be given expressly because of unemployment by the Unemployment Grants Committee, it is a condition of the grant that all contracts for or incidental to the works shall be placed in this country.

All goods and materials supplied under the contract shall be of British production and manufacture.

Plans may be seen and general conditions of contract, specification, quantities and form of Tender may be obtained at the office of the Engineers, Messrs. W. H. Radford and Son, Chartered Civil Engineers, Albion Chambers, King-street, Nottingham, and also at my office, as under, on deposit of Five Guineas (cheque), which will be returned on receipt of a bona fide Tender and the return of the quantities.

The lowest or any Tender will not necessarily be accepted.

Sealed Tenders are to be delivered to me at my office as under on or before April 27th, 1925, endorsed "Chatham Internal Sewers, No. 1."

By Order,
EDWARD B. LEE,
Town Clerk.

Town Hall,
Chatham, Kent,
27th March, 1925. 8796

The Brighton West Pier Company, invite TENDERS for the RE-CONSTRUCTION of their LANDING STAGE, and other work.

Specifications and quantities may be obtained at the West Pier, Brighton, or at the offices of the Engineer, M. Noel Ridley, Standard House, 133, Cardigan-road, Leeds.

Tenders to be sent to the Company, West Pier, Brighton, on or before Friday, the 17th of April, 1925, first post.

The Company do not bind themselves to accept the lowest or any Tender. 8739

PROPOSED BRIDGE OVER RIVER FORTH AT DRIP, STIRLING.

The County Councils of Stirling and Perth invite DESIGNS, along with TENDERS, for NEW BRIDGE, proposed to be erected over the River Forth at Drip, Stirling. Further details may be obtained from Mr. D. R. Cox, Road Surveyor, Stirling, and Mr. W. L. Gibson, Road Surveyor, Dunblane. Designs and Tenders should be lodged with the subscriber on or before Thursday 30th April next.

The County Councils do not bind themselves to accept any Design or Tender.

JAMES LEARMONTH,
County Clerk.

County Buildings, Stirling,
26th March, 1925. 8795

Urban District Council of GOOLE.

The Goole Urban District Council invite TENDERS for SUPPLYING, ERECTING and SETTING TO WORK a STEAM PUMPING PLANT at their new Waterworks Borehole at Pollington Pumping Station near Snaith.

The Plant will consist of a Borehole Pump capable of lifting 56,000 gallons of water per hour from a depth of 200ft. below ground level, and a Force Pump for delivering the same quantity of water to Goole against a total head of 320ft., Two Boilers, an Economiser, an Overhead Traveller, an Electric Lighting Set, and all necessary auxiliary gear.

A preliminary plan of the suggested lay-out, with copies of the conditions of contract and specification, can be obtained on payment of a deposit of £5 (which will be returned on receipt of a bona fide Tender) at the Offices of the Council, Stanhope-street, Goole, or at the Offices of the Consulting Engineer, Mr. E. J. Silcock, M. Inst. C.E., 25, Victoria-street, Westminster, and 10, Park-row, Leeds.

Sealed Tenders, endorsed "Pumping Engines," must be addressed to the Chairman of the Gas and Water Committee, and be delivered at the Council Offices, Goole, not later than the 13th May, 1925.

The Council do not bind themselves to accept the lowest or any Tender.

J. W. PULLON,
Clerk to the Council.

Council Offices, Goole,
26th March, 1925. 8837

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PUBLIC NOTICES

Southampton Corporation
WATERWORKS.
OTTERBOURNE PUMPING STATION.

The Corporation invite TENDERS for the SINKING of a RECTANGULAR WELL and BORING of TWO BORE-HOLES, 10ft. 6in. and 9ft. diameter, Heading, Driving and other work.

Plan, with conditions of contract, specification, quantities and form of Tender, may be obtained from Mr. E. C. Rodda, Waterworks Engineer, 21, Shirley-road, Southampton, upon production of the Borough Treasurer's receipt for a deposit of £2 2s.

Deposits will be returned after the Council have dealt with the Tenders to contractors who have submitted bona fide Tenders.

Sealed Tenders, endorsed, "Tender for Well Sinking, Borings, Heading, Driving, &c.," must be delivered at the Town Clerk's Office on or before the 18th April, 1925.

No pledge is given to accept the lowest or any Tender.

R. B. LINTHORNE,
Town Clerk.

30th March, 1925. 8809

SITUATIONS OPEN

WANTED, a CIVIL ENGINEERING ASSISTANT, temporarily, for Waterworks Construction.—Address, stating age, experience and salary, 8839, The Engineer Office. 8839 A

WANTED, ASSISTANT CIVIL ENGINEER for contract in France, speaking and writing French fluently.—State qualifications, experience and salary, H. T. JENKINS and SON, Ltd., Torquay. 8812 A

WANTED FOR INDIA.—MECHANICAL ENGINEER, capable of Erecting Steam-driven Vertical Air Compressors, Lancashire Boilers, Auxiliary Plant (Feed Pumps, &c.).—Address, with full particulars and references, and stating salary required, 8821, The Engineer Office. 8821 A

A FIRM Who are Putting on the Market an Electro-mechanical Hammer which is equal in all respects to a pneumatic hammer, but which runs off an ordinary electric light socket at very small cost, is OPEN to ENGAGE a first-class MAN of proved ability to INAUGURATE a SALES CAMPAIGN. Preference will be given to a man who is thoroughly conversant with the Pneumatic Tool Trade, and who has already held a similar position.—Replies, which should give full details of experience and salary required, will be treated confidentially.—Box 295, Dorland's, 14, Regent-street, S.W. 1. P469 A

BLUE PRINTING.—MAN to Take Charge of Manufacturing Engineers Blue Print Room and Drawing Files. Must have knowledge of Rotary Blue Printing Machines and modern Photostatic and Reproduction Processes, together with experience of Routine Filing and Card Indexing.—Address, stating age, experience and salary required, 8742, The Engineer Office. 8742 A

CIVIL ENGINEERING ASSISTANT REQUIRED by Public Works Contractors. Must have thorough knowledge up-to-date Civil Engineering Practice and competent to set out works. Capable of abstracting quantities and preparing data for estimating, also knowledge of Plant. Good remuneration to right man.—Address, with full particulars, 8802, The Engineer Office. 8802 A

ESTIMATOR WANTED, Well Trained and with sound knowledge of Reciprocating Pump Work; Correspondence Experience preferred. State age, experience and salary required.—Address, P473, The Engineer Office. P473 A

THE PHŒNIX OIL and TRANSPORT CO., Ltd., operating in Roumania, has VACANCIES for a number of GRADUATES in the FACULTY of ENGINEERING, MINING, CIVIL or MECHANICAL, for POSITIONS as PROBATIONERS.

Particulars can be obtained from COMPANY'S OFFICES, 6, Princes-street, Bank, London, E.C. 2. 8813 A

DRAUGHTSMAN and ASSISTANT to WORKS MANAGER for Small Works, South Wales, WANTED, man about 30, with shops and drawing office experience, used to general mechanical engineering and preferably some structural experience. Man used to Colliery and Steel Works Plant preferred.—Address, P474, The Engineer Office. P474 A

DRAUGHTSMAN, for Pipe Work Arrangements and Detail, capable of taking own dimensions on site. Age, experience, salary, earliest date commence.—AITON and CO., Ltd., Derby. P477 A

DRAUGHTSMAN, Grade III., REQUIRED for Plant Drawing Office. Candidates must have had good training and some experience of Structural and Plant Work. Salary between 40s. and 52s. a week, plus Civil Service Bonus, giving present totals of from 60s. 11d. to 86s. 4d.—Apply, quoting A.56, to the SUPERINTENDENT, R.A.E., South Farnborough, Hants. 8805

DRAUGHTSMAN REQUIRED for Design and Details of High speed-Engines. Must be thoroughly conversant with Back Pressure Work.—Address, 8800, The Engineer Office. 8800 A

DRAUGHTSMAN, SENIOR, with First-class Experience on Power or Instrument Transformer Work.—Address, stating age, qualifications, and salary required, and earliest date could commence, 8550, The Engineer Office. 8697 A

DRAUGHTSMAN, Skilled in Design and Lay-out of Mechanical Handling Plants for Ore and Coal. Men without actual experience need not apply. State age, experience, and salary required.—Address, 8683, The Engineer Office. 8683 A

DRAUGHTSMAN to take Charge of a Small Drawing-office. Marine Auxiliaries and Refrigerating Machinery. Must be capable of modern design and speedy output.—Address, 8831, The Engineer Office. 8831 A

DRAUGHTSMAN, with All-round Experience o Construction of Water-wheel Alternators, REQUIRED by Old-established Firm.—Address, with full particulars of experience and salary required, to 8820, The Engineer Office. 8820 A

DRAUGHTSMEN.—BEFORE NEGOTIATING with Government Departments in connection with any post, PLEASE COMMUNICATE with the GENERAL SECRETARY, Association of Engineering and Shipbuilding Draughtsmen, 96, St. George's-square, London, S.W. 1. 7871 A

DRAUGHTSMEN WANTED by Firm of Westminster Engineers. Must have thorough knowledge and experience of works in connection with Dock, Harbour and large Public Works Contracts.—Apply, giving full particulars of age, experience, and salary required, to Box 547, c/o Brown's, Tothill-street, Westminster, S.W. 1. 8814 A

EXPERIENCED DESIGNERS REQUIRED for Constructional Steel Work with good knowledge of calculations and details for all types of Steel-framed Buildings.

Candidates should have had at least 3 years' training with a Steelwork Contractor, and be capable of preparing steelwork schemes from Architect's drawings, and must have served in H.M. Forces during the War.

Applications, in writing, not later than 17th April, to "L. J.," c/o Charles Barker and Sons, Ltd., 31, Budge-row, E.C. 4, with not more than three copies of recent testimonials, and particulars of training, experience, age, salary required, and service in Forces. 8804

SITUATIONS OPEN (continued)

HEAD DRAUGHTSMAN for Structural Works, Glasgow district; must have sound theoretical and practical experience; age between 30 and 40; salary about £500 or over, according to qualifications.—Address, with full particulars, P442, The Engineer Office. P442 A

INDIA.—DRAUGHTSMAN REQUIRED, with Practical experience in Bridge and Light Structural Work and good knowledge of theory.—Write, with copies of testimonials and full particulars of training and experience, to "Z. D. 293," c/o Deacon's, Leadenhall-street, London, E.C. 3. 8851 A

JUNIOR DRAUGHTSMAN WANTED for Factory in S.E. London, preferably about 20 years of age, and with good general engineering experience.—Address, stating age and experience, to 8828, The Engineer Office. 8828 A

RECIPROCATING PUMPS.—WANTED, a Competent DRAUGHTSMAN. State age, experience and salary required.—Address, 8847, The Engineer Office. 8847 A

REQUIRED for BRISTOL AREA.—First-class leading DRAUGHTSMEN and JUNIORS accustomed to chemical engineering work.—Apply by letter, giving details of experience, &c., and salary required, to THE NATIONAL SMELTING CO., Ltd., Central Office, Avonmouth. 8811 A

REQUIRED (London), DRAUGHTSMAN, Experienced Water-tube Boilers and Boiler-house layout. State experience, age, and salary required.—Address, P466, The Engineer Office. P466 A

WANTED, FOUNDRY FOREMAN and GENERAL MANAGER, Iron Castings only, green and dry sand. Must be conversant with Machine Moulding. Present total output about 25 tons per week. Midlands district. Good position for suitable man. State experience, age and terms.—Address, 8715, The Engineer Office. 8715 A

LOCOMOTIVE FOREMAN TURNER with 4ige. Spanish rega., S. America. Single, 25/32. Prev. exp. same work. £250, qtrs., passage, &c.—Apply, LAURIE'S, Employment Specialists, 28, Basinghall-street, E.C. 2. No preliminary fee. 8817 A

WORKS FOREMAN REQUIRED for London District, with initiative and energy. Must be experienced in Mass Production of small mechanical details, a capable organiser, and accustomed to control of labour. Write, giving full particulars, when disengaged, salary required, and enclosing copies of two references, to "Z. F. 296," c/o Deacon's, Leadenhall-street, London, E.C. 3. 8833 A

STOREKEEPER, London District, Responsible and Efficient Man, for STORES in Engineering Works. Thoroughly acquainted with the duties entailed and able to execute them. Only those with long experience need apply, with full particulars, stating salary, when disengaged, and enclosing copies of two references, to "Z. G. 297," c/o Deacon's Advertising Agency, Leadenhall-street, London, E.C. 3. 8834 A

SITUATIONS WANTED

A FIRST-CLASS MECHANICAL and ELECTRICAL ENGINEER, holding the degrees of M.Sc., A.M.I.C.E., and M.I.A.E., and with the following experience, is prepared to CONSIDER OFFERS of APPOINTMENT.

Four years' University training, eighteen years' works and office experience, with well-known English firms; has held responsible positions on both works and sales side. Until recently held position of sales and technical manager of large engineering firm.

First-class reputation and connection.

Address, P465, The Engineer Office. P465 B

ADVERTISER, Age 30, DESIRES POSITION. First-class commercial experience, knowledge engineering, accustomed office management, buying, secretarial work and correspondence, excellent references, single; moderate salary.—Address, P475, The Engineer Office. P475 B

CIVIL ENGINEER (Young), B.Sc., SEEKS NEW APPOINTMENT; 5 years' works and office experience in constructional dept. of large gas co. Will go abroad.—E. O. ROSE, 114, Bethune-road, N. 16. P472 B

ENGINEER (32) SEEKS Assistant Works Manager's or any Works Executive POSITION with scope. Shop production experience, charge tool, design, planning, practical; London district preferred.—Address, P476, The Engineer Office. P476 B

RESIDENT ENGINEER, POSITION as, WANTED AT ONCE. Parliamentary work, contract plans, construction of railways, bridges, tunnels, roads, &c., estimating and costs.—Address, P468, The Engineer Office. P468 B

SECRETARY-MANAGER, with Extensive Experience in automatic packing and wrapping machinery, &c., manufacture and sale, DESIRES similar APPOINTMENT or any other position of responsibility and trust. Highest qualifications.—Address, 8738, The Engineer Office. 8738 B

STRUCT. ENG. ASSISTANT (19), 4 Yrs. D.O., surveying, detailing and calculations, steel and r. concrete, SEEKS POSITION with Contractors.—F. C., 15, Oakdale-road, Forest Gate, E. 7. P470 B

MACHINE and FITTING SHOP FOREMAN REQUIRES SITUATION. Good all-round experience in general engineering.—Address, P478, The Engineer Office. P478 B

TUBE BENDER, Over 20 Years' Experience, WANTS SIT, either as Bender or Foreman, giving prices for Estimating, &c.; 21 years' references.—F. J. NORRIS, Albion-hill, Loughton, Essex. P471 B

PARTNERSHIPS

IF YOU ARE SEEKING
A PARTNER or PARTNERSHIP
or wish to buy or sell a
BUSINESS or WORKS
Write:
WHEATLEY KIRK, PRICE & CO.,
46, Watling Street,
London, E.C. 4.
Established over 70 years.

BUSINESS MAN WISHES to MEET Energetic Practical ENGINEER willing to Assist in Developing an important Industrial Process on co-operative lines. Excellent prospects. Small capital desirable, but not imperative. State in confidence full particulars, age, qualifications, and commencing salary required.—Address, 8810, The Engineer Office. 8810 C

ENGINEER, With £1000 to £1500 Capital, SEEKS POSITION of responsibility in sound concern. Has good general experience, excellent references.—Address, P479, The Engineer Office. P479 C

ENGINEER REQUIRED as DIRECTOR, with £2000-£3000, to Manage Motor Cycle Works, Midlands; turnover £40,000, large orders in hand. Good salary to competent production man.—ARNOLD and CO., 143, Cannon-street, E.C. 8852 C

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A Seven-Day Journal

French Shipbuilding Credits.

The French shipbuilding industry has been for so long in a precarious situation that the Government has found it necessary to come to its assistance by offering loans to shipowners. The ostensible object of the loans is to compensate shipowners for some of the additional burdens imposed upon them by the application of the eight hours' working day to the mercantile marine. Shipowners, however, declare that they do not want State loans, the payment of which they regard as problematic in the present state of the country's finances, and which would certainly not cover anything like the losses sustained. The new Bill, nevertheless, provides for such loans, which are to be applied mainly to assist in the building of ships. Vessels constructed with this financial aid must not be sold abroad within a period of ten years, except with the permission of the Under-Secretary of State for the Merchant Marine. The total amount of the credits will be fixed each year. For the present year the amount will not exceed 150 million francs, 20 millions of which will be available as direct subsidies to shipowners to indemnify them partially for the application of the eight hours' day. The loans for shipbuilding will involve interest not exceeding 3 per cent., and may be repaid at any time within a period of twenty years. The sum required for the subsidies and loans will be raised by a tax of 1f. per ton on the sea-borne goods traffic, which will be doubled when the value of the goods exceeds 3000f. a ton, and by a tax of from 2f. to 10f., according to class and category of ships, on each passenger embarking and landing at the ports. As this Bill is the direct outcome of the application of the eight hours' day, which shipowners declare to be inoperative, and as the system of taxation is strongly opposed by the maritime interests, it is by no means certain that the measure will pass the Senate in its present form.

Coventry Gasworks.

The Coventry Gas Committee has just recommended that work should be started on some large extensions of the Corporation gasworks at Foleshill which will involve the expenditure of over a quarter of a million sterling. The works are part of a scheme originally approved in 1919 which are estimated to cost £425,000, and application is to be made to the Board of Trade for powers to borrow £350,000 for the extension of the gas-making plant and the mains. It is proposed to install new vertical retorts, with a total capacity of 2½ million cubic feet of gas a day, at a cost of £96,000, and a 5 million cubic foot gas holder and tank, at a cost of £90,000. The railway sidings are to be extended and sundry other subsidiary works carried out. It is noteworthy that since the Corporation acquired the gasworks in 1884 the output of gas has been doubled every twelve years.

The Shannon Power Scheme.

On March 29th the Free State Minister for Industry and Commerce introduced a resolution in Dail Eireann empowering the Government to proceed with the Siemens-Schuckert scheme for the hydro-electrical development of the river Shannon. But opposition to the German firm's proposal is increasing daily among Irish engineers and others, and it is reported that a motion has been introduced in the Senate calling for a technical commission to examine the Siemens-Schuckert proposals. The general feeling throughout the Free State is that nothing ought to be done in a hurry. The Shannon scheme is so gigantic that the utmost caution is demanded, especially as the possibilities of developing a demand for 150 million units of electricity per annum seems rather remote. In view of the fact that the present demand does not exceed one-third of this figure, scepticism is widespread. The experts have condemned the proposal to develop an electro-chemical industry in the Free State, and without some such new field of enterprise it is difficult to see how the ambitious anticipations of the Free State Government can be justified.

The Disappearing Smith.

The conclusions just arrived at by a special Conference convened by the Kent Rural Community Council may, let us hope, help to check the disappearance of one of the oldest handicrafts of the countryside. We refer to the village smith, who is slowly, but surely, becoming extinct. Taking Kent alone, there were 729 master smiths a generation ago, while there are only 386 at the present time, and the total number of men employed in the trade has dropped from 1260 to 841 in twenty years. The process is only natural, in view of the introduction of engines in the place of horses for many agricultural purposes, as one of the principal occupations of the smith was originally that of farrier. On the other hand, the mechanical appliances of to-day require maintenance and repair, and it would be a convenience to the farmers if this work could be carried out locally. Unfortunately, the village smithy is seldom equipped for such work, and the craft is gradually falling into desuetude through lack of appropriate jobs. The Kent Conference has consequently suggested that smithies should be equipped with modern machinery, such as a lathe and oxy-acetylene blowpipe, so that they might undertake more elaborate work than they have hitherto done. The men are still to be found, and as a class are most versatile, so much so that it would be a pity if they were altogether crushed out of existence by modern progress. Another innovation of the same character, but of perhaps an even more practical nature, is that of the North Riding Rural Development Sub-committee, which has arranged for a travelling van equipped with oxy-acetylene welding plant, emery grinding and drilling machines, a lathe, and a general equipment of small tools, to make a tour of the Yorkshire villages and give demonstrations to the local smiths of the utility of such modern equipment.

Underpinning Durham Castle.

For some time past work has been in progress on the reparation of Durham Castle, and a start has just been made on the delicate operation of building some concrete buttresses and walls which will connect the original structure with new foundations. Apparently the present cracked condition of the castle fabric is another example of the lack of foresight of mediæval builders in founding their structures on unstable soil, as it has been discovered that the foundations of the castle, which are on the edge of the cliff leading down to the river, are 30ft. above solid rock. The strengthening work, which is being carried out under the supervision of Sir Francis Fox, includes a large amount of grouting with liquid cement—11,000 gallons have already been used—and the use of bronze bars to tie the old fabric together.

The Shipbuilding Trades Investigation.

On Friday of last week a joint conference of representatives of the Shipbuilding Employers' Federation and of the unions of all the men engaged in the shipbuilding and ship-repairing trades took place at St. Pancras Hotel, London. The meeting was a widely representative one, and was addressed by Mr. John Barr, the chairman of the Employers' Federation. Mr. Barr dealt with the situation created by the recent Furness-Withy orders and foreign competition generally, and outlined the disabilities of the British shipbuilder, which mainly arose from the higher wages paid, the shorter number of hours worked, and the excessive demarkation and subdivision of labour. Remedies suggested were payment by results and the introduction of more labour-saving machinery. On behalf of the employers, he proposed that a joint investigation should be made into the position of the industry with respect to costs arising outside the shipyards, as well as those originating within the yards. Many questions were asked by trade union representatives, and were answered by Colonel James Lithgow. It was elicited that the employers' desire was to have a full and free exchange of views in committee, with the object of arriving at definite conclusions as to the best means of re-establishing British pre-eminence in the world's shipbuilding industry. The trades unions have referred the matter to their various executive committees for early discussion, and it is hoped that committees of investigation will shortly be set up.

Dry Docking the Majestic.

Some further particulars regarding the dry docking of the White Star liner Majestic on Thursday last are now available. We learn that the operation was carried out with complete success. The large liner cast off from her berth in the Ocean Dock, Southampton, at 11.30 a.m., and was taken in charge by nine tugs. Within half an hour she was swung round, and by 12.25 p.m. the towing operation was finished, and all that remained to be done was to make the vessel fast in the dock. The operation of pumping out the submerged dock began about an hour later, and was completed at seven o'clock in the evening. The displacement weight of the Majestic is some 64,000 tons, but by removing her oil and stores this figure was reduced to 56,551 tons net, which was an increase of some 4000 tons over the largest weight of ship previously lifted. During the operation the Majestic's new commander, Captain G. R. Metcalfe, was on the bridge, and her late commander, Sir Bertram Hayes, was an interested spectator.

Wages in the Engineering Industry.

The conference held at the beginning of February between the Engineering Employers' Federation and the representatives of the various trades unions associated with the engineering industry came to a close without any definite decision being reached regarding the men's claim for an all-round advance of 20s. per week in the wages of adult workers. The employers intimated that they would be prepared to consider a wages advance provided the unions would agree to a modification of existing workshop conditions, such as would enable the employers to meet the enhanced wages without further imperilling their position in the competitive markets of the world. The unions expressed their regret at the desire of the employers to associate the question of working conditions with the question of a wages increase and withdrew to report and consider the matter. Virtually a deadlock thereupon ensued until on Thursday of last week the Minister of Labour intervened with the suggestion that each side should appoint a small committee to meet and discuss the wages application. Both parties agreed, and on Tuesday the two committees met for the first time, with Sir Allan Smith and Mr. J. T. Brownlie as the respective chairmen. The conference lasted over six and a-half hours and was then adjourned. Secrecy is being preserved as to the exact situation, but it is believed that certain difficulties have been met and that matters are in a delicate state. It is to be inferred that at the joint sub-committee meeting the employers' representatives adhered to their desire to consider the wages question and the question of workshop conditions together. The unions' representatives, it seems, equally persisted in their attitude of treating the two matters separately. It is gathered that a full conference of all the unions concerned will be summoned for a date following Easter in order to decide on the policy to be followed in view of the employers' attitude.

L.M.S. Locomotive Contracts.

It has been officially announced that the London, Midland and Scottish Railway is about to place orders for nearly a hundred new engines in the Glasgow district. These engines form part of the programme of new work announced by the company at the beginning of the year, and are to be built partly at the old Caledonian works at St. Rollox and partly at the works of private builders. The expenditure on their construction, it is stated, will amount to a total of about £750,000. These orders have followed closely upon the announcement that the company had placed a contract with Hurst, Nelson and Co., Ld., of Motherwell, for seven five-coach trains, at a total cost of about £100,000, and another one with Pickering and Co., Ld., of Wishaw, for thirteen coaches. Since the London, Midland and Scottish Railway was formed, it has made provision for the construction of 2303 new passenger coaches, 45,000 goods wagons, and 485 passenger and goods locomotives.

Air Defence.

In connection with the development of the air defence scheme initiated about two years ago, the Air Ministry has placed a contract, valued at £100,000, with Wright, Anderson and Co., Ld., structural engineers, of Gateshead, for the construction of ten steelwork sheds for housing aeroplanes. It is understood that the completed defence scheme will result in the bringing into use of some thirty aerodromes throughout the country, some of which will be new and some of which will be war-time aerodromes at present on the disposal list. When the scheme has been fully established the Air Defence Force will consist of fifty-two squadrons, comprising a total of about 600 machines. Eighteen of these squadrons are already in existence, and by the end of another year it is anticipated that eight more will have been formed. The remaining twenty-six squadrons are to be established within about six years from the inception of the scheme.

New Electric Services on the Southern Railway.

On Wednesday last the Southern Railway opened the Sutton and Coulsdon extensions of its electrified systems, representing the first stage of completion in a scheme of reconstruction which will cost £7,750,000. Eighty-two track miles have now been added to the company's electric system. Alterations have also been made at three stations and a new one has been built at Carshalton Beeches. The work of rebuilding the Sutton Station at a cost of £100,000 has been started and over 100 new carriages have been provided for this section, to meet the anticipated demands from the neighbourhood, which is rapidly growing. The service as reframed to develop the new conditions brings the number of electric trains in and out of Victoria up to over a thousand a day. The additional trains will be run every twenty minutes each way, all stations north of Selhurst having a continuous service with ten-minute intervals.

Airship Experiments.

The British Airship R33, a sister ship of the celebrated R34, which performed the double cross-Atlantic voyage in 1919, has now been reconditioned and equipped for scientific experiments at the Cardington airship works. The research work, it is intended, will provide data required in connection with the design and construction of the five million cubic foot airship about to be built by the Air Ministry. Particular attention is to be paid to the stresses imposed on the ship's structure during manœuvring. The experiments are to be conducted from the Pulham station in Norfolk.

The British Steam Railway Locomotive from 1825 to 1924.

By E. L. AHRONS, M.I. Mech. E.

No. XIV.*

PERIOD 1849 TO 1855 (*continued*).

Mixed Traffic 0–4–2 *Engines.*—This, the oldest, type of six-wheeled goods engine, introduced in 1833 by R. Stephenson and Co., still continued as a handy locomotive for all work. The engines—Fig. 94—built by the Vulcan Foundry in 1853–4 for the Shrewsbury and Chester and Shrewsbury and Hereford railways, present some details of interest. Both outside and inside frames were welded solid from end to end, and a great improvement was made in that the

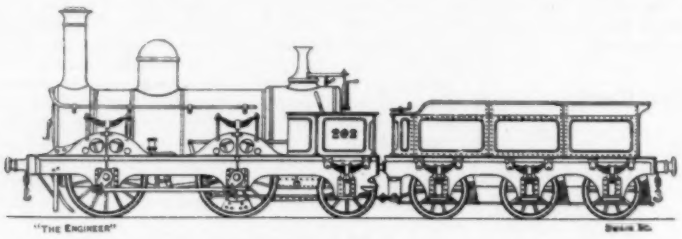


FIG. 94—SHREWSBURY AND CHESTER RAILWAY, VULCAN ENGINE, 1853

inside frames, instead of stopping short at the front of the fire-box casing, also extended from the front to the back buffer beams. The steam chest was A-shaped and placed below the centre line of the cylinders. The wheels had balance weights when new. The cast iron hornblocks were outside the frames, the extra long spring pillars being placed outside the splashers. The latter were of cast iron, of a somewhat heavy and clumsy pattern. The valve spindles were horizontal, with their centres on a level with the centre of the leading axle, to clear which a square frame was inserted in the spindle to embrace the axle. The cylinders were 16in. by 24in., coupled wheels 5ft. diameter, and trailing wheels 3ft. 6in. diameter. A larger boiler than was then usual was provided, which contained 185 $2^{1}/_{16}$in. tubes, and supplied a total heating surface of 1211 square feet, towards which the fire-box contributed 85 square feet.

In contrast to the above, Sharp's standard mixed traffic engine of 1848 to 1854—Fig. 95—is illustrated. This was a simple straightforward design, which, with variations in a few details and dimensions, was built for a period of nearly forty years, chiefly for railways in Wales and Ireland, though a fair number were to be found in other parts of the United Kingdom. The design shows the hand of Charles Beyer, who, until 1854, was responsible for most of Sharp's engines. The cylinders, 16in. by 22in., were inclined with the steam chest between them, and the

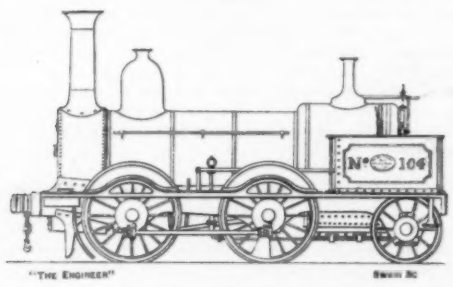


FIG. 95—SHARP BROTHERS' ENGINE, 1848 - 1854

motion was both direct and accessible. The coupled wheels were 5ft., and the trailing wheels 3ft. 6in. diameter. The naves of these early engines were of cast iron, though in later engines solid wrought iron wheel centres were used. The boiler, 3ft. 8in. diameter, contained 145 2in. tubes, and the total heating surface was 866 square feet.

Six-wheels Coupled Goods Engines.—As in the case of the four-coupled passenger engines, double frames and outside cranks were now generally adopted for main-line goods engines, except by McConnell on the London and North-Western Railway. For mineral traffic at slower speeds the inside framed long boiler engine held its own, more especially on the North-Eastern, Stockton and Darlington, and London and North-Western railways.

Of the types of double-framed engine, the majority had sandwich frames, such as those by Stephenson, Hawthorn, and Wilson on the Great Northern, North-Eastern and other lines. On the two railways mentioned—except in the case of about twenty engines completely reconstructed between 1870 and 1880 by P. Stirling on the G.N.R.—(outside) plate frames were never used, but on the Midland, which was until 1874 emphatically in favour of double-framed engines, sandwich frames for goods engines were discarded by Matthew Kirtley in 1852 in favour of outside plain plate frames. A typical sandwich-framed goods engine by E. B. Wilson was illustrated in The Engineer, October 15th, 1920, page 371.

The usual size of cylinders was at this period 16in. by 24in., but a limited number of 17in. and 18in. by 24in. engines were built in 1852–54. For some reason, these larger cylinders did not find favour, and those 17in. diameter were subsequently lined up to 16in., whilst the 18in. cylinders were reduced to 17in. diameter. These were hardly cases of "over-cylindering" with small boilers, since the latter for the 17in. engines had up to 1180 square feet of heating surface, of which 112 sq. feet were in fire-box surface, and were amply large for the duty. Rather does it appear to have been coke consumption that decided the alteration, and in some cases also the arrangement of the valve gear. The diameter of coupled wheels of most engines was 5ft. to 5ft. 3in.

It was still very unusual to weld the outside frames, and in an engine for the Midland Railway built by Kitson and Co., 1852, the horns were formed of two ½in. plates bolted on to each side of the main 1in. plate, which was in four lengths. The horn plates were connected by rectangular tie bars, bolted on to form a tension member of the structure. The inside frame extended from the front buffer beam to the front of the fire-box casing only, and was therefore defective in that the drawbar pull was taken from a strong angle iron riveted to the back of the casing, so that the fire-box was called upon to transmit the pull between driving axle and drawbar. E. B. Wilson's design was inferior to Kirtley's, in that the inside frame was not connected to the front buffer beam, but stopped short at the front of the cylinders, which were attached to it in the usual manner. It was this form of double frame, with a short inside frame extending between cylinders

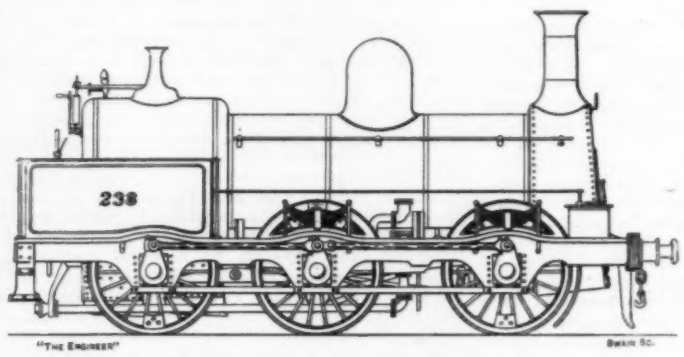


FIG. 96—M.S. AND L. RAILWAY, GOODS ENGINE, 1852 - 4

and fire-box casing only, which threw the driving bearings out of alignment and caused the breakage of crank axles. When D. K. Clark pointed out the defects of double-framed engines, this was the usual design, and that in which *both* inside and outside frames extended the full length of the engine from front to back buffer beams had appeared only shortly before in 1851 and only in Hawthorn's 2–2–2 engines.

The Midland engines of 1852 by Stephenson (260 class) and Kitson (270 class) had 17in. by 24in. cylinders and large boilers, which in the case of the former were 4ft. 3in. mean diameter, 4ft. 4in. diameter outside the largest ring. The barrel was 11ft. 6in. long, and the fire-box casing was flush. Total heating surface of the Stephenson engines was 1184¾ square feet, of which the fire-box provided 106.6 square feet, that of the Kitson engines being 112 square feet. Owing to the use of a transverse partition in the fire-box, the grate area was reduced to 13.4 square feet. Coke was the fuel used. The smoke-box was of the drumhead type flush with the barrel, but in the engines built in 1853 and subsequently (280 class), the drumhead type was discarded, and the raised smoke-box with angle ring attachment was substituted. A characteristic of the Midland goods engines was the long wheel base. In 1850–2 it was 16ft., equally divided, increased to 16ft. 3in. in the 1853–7 engines, and to 16ft. 6in. in those built from 1858 onwards.

The 0–6–0 goods engines—Fig. 96—built in 1852–4 by Stephenson and Sharp, Stewart for the Manchester, Sheffield and Lincolnshire Railway, to R. Peacock's general instructions, were amongst the most powerful in the country. The outside plate frames were welded solid, and ante-dated McConnell's express engine with similar frames by a few months. The cylinders, 18in. by 24in., placed at 2ft. 3in. centres, were inclined downwards with the slide valves placed at a ∧ angle underneath. The coupled wheels were 5ft. diameter and the wheel base 14ft. only, the trailing axle being brought forward to the middle of the fire-box, through which it passed, by means of a bridge—as shown in Fig. 97—formed in the casing and box, which divided the grate into front and back portions. This bridge was an endless source of trouble, owing to leakages.

The boiler was 4ft. 4in. diameter, and that of the Sharp, Stewart engines contained 229 2in. tubes, of which the heating surface was 1427 square feet, to which the fire-box added 145¼ square feet; total, 1572¼ square feet; pressure, 120 lb.; weight in working order, 33¾ tons. Both connecting and coupling rods were of circular section. After running for a number of years, many of these engines had the diameter of the cylinders reduced to 17in.

McConnell's main-line fast goods engines on the southern division of the L. and N.W.R. were examples of more modern practice, and were remarkable in that large six-coupled wheels, 5ft. 6in. diameter, were employed. The first eleven engines were built in 1854 by Kitson and Co., and between 1856 and 1863 ninety-five more were built at Wolverton. The latter, one of which is shown in Fig. 98, differed from those built in 1854 in a few minor details only, such as the position of the sand boxes and the addition of injectors.

The cylinders were 16in. by 24in.; wheel base, 15ft.; the boiler barrel, 10ft. long by 4ft. 4in. diameter, contained 234 1¾in. tubes; and the total heating surface, towards which the fire-box contributed 109 square feet, was 1309 square feet; grate area, 16.3 square feet; the total weight in working order was only 26 tons 12¼ cwt.

The Lancashire and Yorkshire Railway engines, without exception, had inside frames, and twelve goods engines built by the company in 1854–5 for the Oldham gradients had 18in. by 24in. cylinders. The experience with these engines was similar to that of other railways, and nearly all of them subsequently had the cylinders reduced to 17in. diameter. Their weight was 33 tons 13 cwt.

In contrast with the majority of the main-line goods engines, which had double frames, the 0–6–0 mineral traffic engines were of Stephenson's long boiler type, with inside frames only. These were to be found on most of the principal railways, but chiefly on the Stockton and Darlington, North-Eastern and London and North-Western (Southern Division). Those on the last-mentioned railway were of large size, with 18in. by 24in. cylinders and 5ft. wheels, having been copied by McConnell from Sharp's "Sphinx" class of the M.S. and L. Railway. A number by Fairbairn, 1852–4, had boilers containing 200 2¼in. tubes, 14ft. 4in. long, and fire-boxes with transverse partitions, the total heating surface being 1714 square feet. Two others by the same makers, had 247 2¼in. tubes and larger fire-boxes, with a longitudinal partition, and gave a total heating surface of no less than 2082 square feet, though the grate area was only 16.32 square feet. Three others were provided by McConnell with a long fire-box with three longitudinal partitions,[1] and the patented combustion chamber. Into these boilers 305 short tubes were packed. The tube heating surface was 978 square feet, and that of the fire-box and combustion chamber 339 square feet; total, 1317 square feet. The engines weighed from 30 to 33¼ tons in working order, according to the size of the boilers. All boilers with a single longitudinal partition had two fire-holes. The earlier

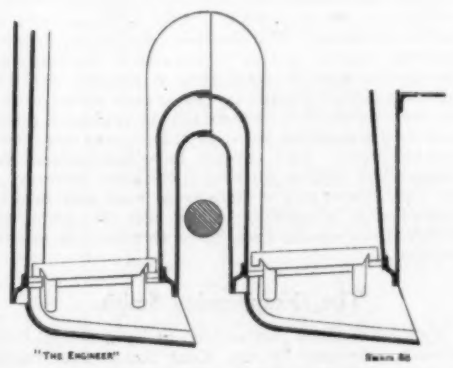


FIG. 97—FIRE-BOX, M.S. AND L. RAILWAY

engines had raised fire-box casings, but from 1854 onwards most of McConnell's engines were built with flush casings. These McConnell goods engines were almost the only engines in which the 18in. cylinders were not reduced in diameter.

On other lines, except the Manchester, Sheffield and Lincolnshire, the 0–6–0 long boiler engines, with

* No. XIII. appeared March 27th.

[1] This statement is from the old official records, but the writer has not seen any drawing or further description of this unique fire-box

inside frames, were of considerably smaller size. The North-Eastern, on which similar engines were built until 1870, generally retained Stephenson's original dimensions of 15in. by 24in. cylinders, and somewhat far back to clear the footplate and take the weight of the tanks and bunker. These engines were of small size, with 12½in. by 18in. cylinders and 5ft. 6in. coupled wheels. The latter were 7ft. 8½in.

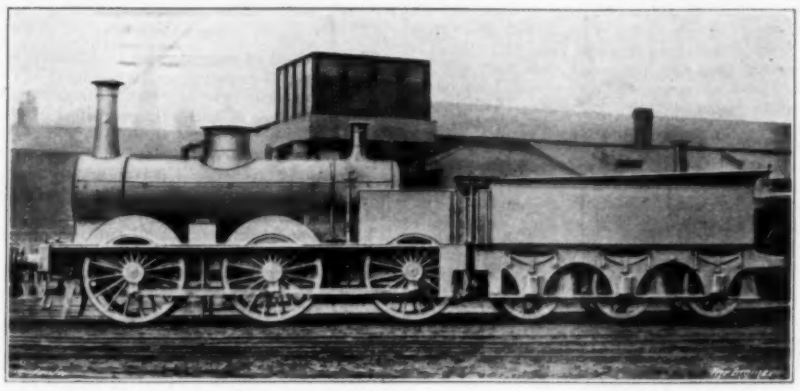


FIG. 98—L. AND N.W. RAILWAY, McCONNELL'S GOODS ENGINE, 1854-1863

wheels varying from 4ft. 6in. to 4ft. 9in. diameter, though there were a few built by R. Stephenson and Co., 1853–5, with 5ft. wheels and 16in. by 24in. cylinders.

By 1849 the Stockton and Darlington Railway had discarded the construction of the Hackworth types and their derivatives, and had also settled down to the Stephenson inside cylinder long boiler engines, the majority of which during the 1852–5 period had 4ft. 2½in. wheels and 17in. by 18in. cylinders.

On all lines conveying coal traffic the short wheel base of the long boiler engine was found to be very convenient when shunting into colliery sidings. The Midland employed a considerable number of the Stephenson type engines for the coal traffic between Leeds and Derby, though none were built after 1852 for that line.

Tank Engines with Coupled Wheels.—Of these, there were as yet comparatively few, either for passenger or shunting service. For passenger traffic Sharp Brothers in 1849 built two 2–4–0 well tank engines for the Monmouthshire Railway—Fig. 99—which, if not actually the first, were certainly amongst the earliest four-wheels coupled tank engines. They were of small size, with 5ft. wheels and 13in. by 18in. cylinders. The wheel centres were of cast iron, with balance weights, and similar in design to those of Sharp's heavy goods engines. The cab shown was a later addition by the Great Western Railway, after the latter had taken over the Monmouthshire Railway.

Messrs. Hawthorn's 2–4–0 well tank of the same period was designed on lines similar to those of their express engine "Plews" of 1848. The outside sandwich frames were of the "arch" form, and the inside frames consisted of two longitudinals placed between the inside cranks and extending from the back of the cylinders to the fire-box casing. The inside cranks were of the Dunham half-crank form, with part of the outside web sunk into the nave of the adjoining wheel. The steam chests were vertical and were placed outside the cylinders immediately

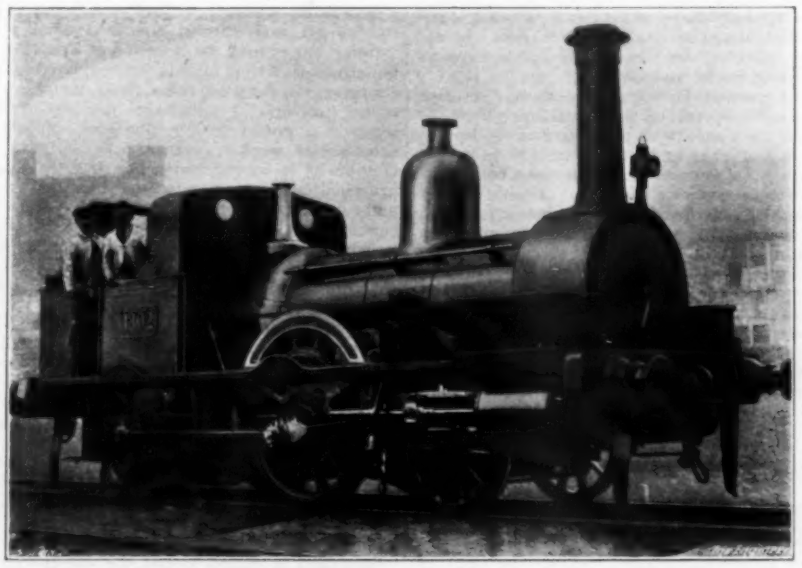


FIG. 99—MONMOUTHSHIRE RAILWAY, SHARP BROTHERS' TANK ENGINE, 1849

behind the outside frames, so that the excentrics were inside the latter and outside the wheels. The exhaust was taken round the lower portion of the cylinders into a central blast pipe, which was parallel throughout its length. The trailing wheels had to be placed apart between centres, and the total wheel base was 13ft. 4in.

Sharp, Stewart's 2–4–0 side tank engine of 1851—Fig. 100—two of which were built for the South

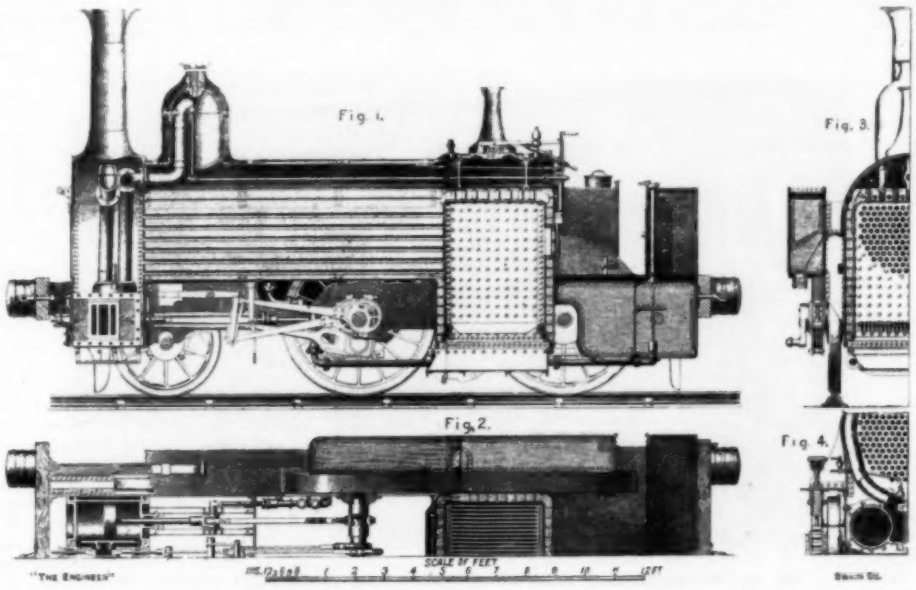


FIG. 100—SHARP, STEWART AND CO.'S SIDE TANK ENGINE, 1851-2

Staffordshire Railway, may fairly be described as the first of a more modern era. Unlike the early eight-wheeled side tank engines—Fig. 72 *ante*—the tanks were shortened to a length such that the motion was rendered accessible for oiling. The cylinders were 16in. by 20in., the coupled wheels 5ft. diameter, leading wheels 3ft. 6in., wheel base 6ft. 6in. + 7ft. The outside frames were of the sandwich type, and the inside frames extended backwards to the firebox casing. The side tanks were supported by the outside frame and were fastened to gussets which, in turn, were riveted to the fire-box casing. There was also a well tank under the coke bunker, connected to the side tanks by a large pipe outside the frames.

A small 2–4–0 well tank engine of unique design was shown by E. B. Wilson and Co. in the London Exhibition of 1851. The peculiarity lay in the boiler, which had two separate barrels and fire-boxes side by side. There was one common smoke-box and both fire-boxes were enclosed within a single casing. The object of the arrangement was not mentioned beyond the statement that firing was to be performed alternately in each box, in which case the principle was similar to that evolved at a later date by Cudworth for coal burning. But whether coal was intended to be used in Wilson's engine is doubtful, and for coke burning the complication was unnecessary. The drawings were made by David Joy. Each boiler barrel was 1ft. 9in. diameter and the two contained 136 1¾in. tubes, of which the heating surface was 694 square feet; total heating surface, 755 square feet; grate area, 7½ square feet. The cylinders were 12½in. by 18in. and the coupled wheel had a diameter of 5ft. This engine was the only one of the type which appears to have been built, and the writer has no record of its subsequent history.

It was only after 1853–4 that the useful four-coupled tank engines really came into their own and began to replace those with single driving wheels. The North London Railway set the example, and the first ten engines for that line, built in 1853–4 by Stothert and Slaughter, of Bristol, were of the 2–4–0 outside cylinder type. They were followed in 1855 by other types, of which mention will be made subsequently.

The four-wheeled, or, in fact, any class of shunting tank engine, was extremely rare. The earliest of which the writer has any knowledge was Bury's 0–4–0 saddle-tank engine with inside cylinders and bar frames, built in November, 1847, for the Shrewsbury and Chester Railway. This engine, with its peculiar lever brake gear actuated by right and left-handed screws, was illustrated in THE ENGINEER, February 2nd, 1923, page 113. A four-wheeled tank engine was built by Sharp Bros. in 1849 for the same railway. The small tanks were hung on each side at the front and held only 470 gallons, and when the water capacity was found to be insufficient a similar pair of tanks were added behind the driving wheels at the back. The wheels were 4ft. 6in. diameter and the wheel base 8ft. long. The cylinders were 15in. by 22in., with valves beneath their centre line, the valve spindles being bent to pass below the leading axle. The entrance to the footplate was on the left-hand side only.

The subject of engine brakes may be mentioned here. Tender engines had no brakes on the engine wheels, the tenders only being fitted with them. This was the universal practice until about 1876, when the use of continuous brakes subjected such a strain upon the engine drawbars that it was found to be necessary to apply a retarding force to the engine itself. There was, in addition, a strong objection to the application of brake power to driving wheels on account of the torsional stresses on the axles. Possibly for this reason some of the early 2–2–2 tank engines of 1850–1, such as those on the Dublin and Drogheda Railway, were entirely unbraked, reliance being placed entirely upon the guard, who applied his van brake on a whistle signal from the driver. When standing in sidings the engine wheels were scotched. As this was dangerous, it became the usual practice, both in the case of single and coupled tank engines, to apply a clasp brake to the trailing wheels only, leaving the driving wheels free, a method which for coupled engines of the 2–4–0 type threw a strain on

the coupling rods. D. Gooch, in the Great Western 4–4–0 tank engines, tried to avoid this difficulty by applying rail skid brakes as mentioned previously.

Most of the few tank engines used at this time for shunting and light goods traffic were of the intermediate shaft type previously described, but it was many years before tank engines were considered necessary for shunting duties. In 1854 Messrs. Stothert and Slaughter built six 0–6–0 well tank engines—Fig. 101—for the main line coal traffic of the Monmouthshire Railway. They had outside horizontal cylinders, 16in. by 22in., and to obtain connecting-rods of sufficient length the latter drove the trailing pair of wheels, 4ft. 6in. diameter, placed behind the fire-box.

Broad-gauge Tank Locomotives.—On the Great Western Railway no important alterations were made between 1849 and 1854 in the designs of the main line tender engines, and the only novelty consisted of four heavy 0–6–0 saddle-tank locomotives which in most details were similar to the tender goods engines. The inside frames were of the sandwich type. The most noticeable feature was the use of compensating levers between both pairs of wheels placed below the frames. The goods tender engines, on the other hand, had the more reasonable arrangement of levers between leading and driving springs only. These engines had 17in. by 24in. cylinders, 5ft. wheels, and a total heating surface of about 1574 square feet, pressure 120 lb. A single sand box was placed centrally in front of the smoke-box and the fireman had to ladle the sand down the two pipes with which it was provided. These locomotives were classed as "banking" engines.

A still more powerful class was built in 1856 for the Vale of Neath Railway by the Vulcan Foundry, Mather, Dixon and Co. seem to have exceeded their instructions, and "gone boldly to 10ft." Brunel "expressed some fear of the feasibility of constructing 10ft. wheels." Special trials of the "Ajax" were made by Brunel during April, 1839, which showed that the engine ran fairly well in good weather and attained an average speed of 30 miles per hour with a load of seven small vehicles, but that "during high gales this engine has been much more delayed than the others." It was suggested that the increased resistance due to the large exposed surface of the disc wheels may have been a possible cause of this. By June, 1843, when the engine appears to have already been withdrawn from service, the "Ajax" had run 15,264 miles. The "Mars" was delivered with 10ft. wheels, but never ran with them, as the railway refused to accept the engine until Mather, Dixon and Co. had substituted 8ft. driving wheels. Illustrations of the "Ajax" and other early Great Western engines appeared in The Engineer Supplement, December 16th, 1910, page xx.

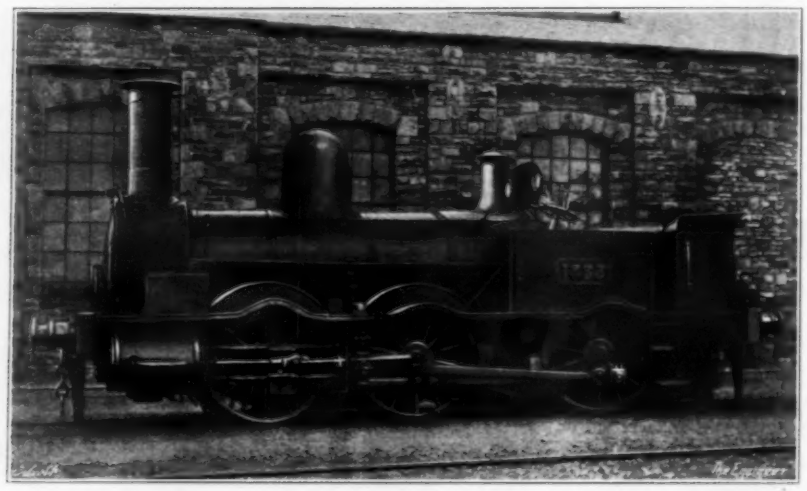


Fig. 101—Monmouthshire Railway, Stothert and Slaughter's Engine, 1854

with 18in. by 24in. cylinders and 4ft. 9in. wheels. These engines had inside plate frames, and compensating levers between leading and driving springs only. In place of Gooch's stationary link motion they were fitted with Dodds's wedge motion as modified by Henry Dübs, then manager of the Vulcan Foundry. The modern form of expansion angle iron bracket riveted to the fire-box and resting on the frames was used. Total heating surface, 1417.6 square feet; weight, 40 tons in working order.[1] They were too heavy for the rails and were afterwards altered to tender engines.

ADDENDA.

In The Engineer of March 27th, page 345, the illustration, Fig. 87, was inadvertently substituted for that of a small "Bloomer" of the 1853 period. Fig. 87 actually represents one of the large, or 7ft., "Bloomers" of 1851–2, to which reference is made on page 344, col. 2. The small "Bloomers" were somewhat similar in outward appearance, but had 6ft. 6in. wheels and flush fire-box casings.

Old G.W.R. Locomotives.—On pages 150 and 151 of The Engineer of February 6th, mention is made of the North Star and other early Great Western engines. The wheel base of the North Star was given as 7ft. + 6ft. 4in. As originally built by Messrs. Stephenson the wheel base was 6ft. + 6ft. 4in.; it was lengthened to accommodate a longer boiler when the engine was afterwards rebuilt.

There were two engines by Mather, Dixon and Co., the Ajax and Mars, which were constructed with 10ft. driving wheels built up of riveted plates in the form of solid discs. It had originally been intended that 8ft. wheels should be used, and this size is that given in Whishaw's tables. Brunel's instructions were that the piston speed at 30 miles per hour was not to exceed 280ft. per minute. The makers wished to increase the length of stroke, and a discussion followed in regard to increasing the diameter of the driving wheels. Brunel agreed to an increase to 9ft., but

[1] Drawings of these engines are to be found in "Recent Practice in the Locomotive Engine," by D. K. Clark and Colburn, 1860, Plate 31.

Apprenticeship in the Royal Ordnance Factories.

By G. W. TRIPP, A.C.G.I., M.I. Mech. E., Assoc. M. Inst. C.E. (Member of Apprenticeship and Training Board).

For upwards of twenty years the Royal Ordnance Factories have operated an approved scheme for training youths to become engineers, and many of these "trade lads," as they were termed formerly, have proved the value of the training afforded by securing distinctions in open competition, such as in the Whitworth examinations, and in scholarships to the Universities, while a number of them have subsequently risen to high positions in their profession. It is gratifying to know that they have not been slow to attribute their success to the thorough grounding they obtained in their early days. The facilities were, however, only granted to a limited number of lads, and a very large proportion of the boys employed in the factories had practically no prospect of advancement even though they might work steadily and devote all their attention to their duties; many indeed found themselves in dead-end occupations, such as explosive filling, bullet making, &c.

When the present Director-General of Factories, Sir Holberry Mensforth, K.C.B., was appointed, he realised that the then existing scheme was too limited in its scope, and after much consideration as well as consultation with some of the up-to-date companies which have been specially successful in their apprenticeship methods, he decided to introduce an entirely new system, and it is the purpose of the present article to describe the scheme which was evolved.

Every boy is given his chance, there being nothing to prevent a lad of the lowest grade rising to the highest position, provided he has the necessary ability, perseverance and grit. There is no royal road to success other than sheer merit; influence has no power, nor does blue blood give any weight.

Juvenile labour may be resolved into three distinct classes:—

Messenger lads;
Shop lads;
Apprentices;

the latter class, the one with which this article is primarily concerned, being subdivided into trade apprentices, engineering apprentices, and student apprentices.

Speaking in a general way, the trade apprentice is intended to become the skilled artisan of the future, while the engineering apprentice may fill a future vacancy among the supervisory posts, *e.g.*, foreman or assistant foreman, and the student apprentice can qualify for positions on the upper management; but it should be emphasised that there is no barrier to prevent up grading; indeed, it is encouraged, and many trade apprentices secure their transfer to the higher class of engineering apprentice, while several engineering apprentices have obtained scholarships to engineering colleges, thereby fitting themselves for future posts on the management staff, their complete training having been in no way inferior to that of the student apprentice.

Recruitment.

The method of recruitment is different for each of the classes of apprentice, as, in the light of experience, no common principle has been found suitable. The trade apprentice is normally recruited internally, and every messenger lad and shop lad, whose position as such could be none other than a blind alley vocation, is encouraged to work with trade apprenticeship in view, and as a result there is always a healthy state of upward mobility.

The lower grade lads are all apprised of the scheme, and at the same time are informed that they should take evening classes, and do their individual part to justify promotion. Records of their work in the factory, their conduct, and application are kept, and reports of their progress are obtained from the educational establishments where they are studying. In this way it is comparatively easy to select from the ranks of messenger lads, lads on bullet making plant, &c., the boys most deserving of consideration for capstan lathe work and other duties, which, though of a higher order, cannot yet be regarded as "skilled" work. The boy has then still further opportunities, for he can register as a candidate for trade apprenticeship. His records are still watched, and when vacancies occur the best of these up-graded lads are selected, and their careers as apprentices definitely begin, for they have then come within the orbit of the apprenticeship scheme.

Recruitment of engineering apprentices is by open competitive examination, and the candidates are divided into two classes with different sets of examination papers. "A" candidates are not less than 14½ years or more than 16½ years on March 1st of the year of examination, while "B" candidates are between the ages of 15½ and 17½ years. The "A" apprentices are given a four years' and the "B" a three years' theoretical course, and it is desirable for the "B" lads to be sufficiently advanced to take the second year theoretical course during the first year of apprenticeship. In order to give the most promising of the trade apprentices opportunities of getting into the higher grade of engineering apprentice, they are allowed to compete for the "A" examination up to the age of about 17½ years.

In the case of both "trade" and "engineering" apprentices, the period of apprenticeship ceases when the lad attains the age of twenty-one years.

The qualification for student apprenticeship is the possession of a degree or diploma in engineering obtained from an approved University or College, following a recognised course taken thereat. The age of the candidate should not normally exceed twenty-four years, and the course of training occupies three years. Selection is made by a committee appointed by the Apprenticeship and Training Board.

Having thus briefly described the methods of obtaining the apprentices the programme of work arranged can be considered.

Trade Apprentices.

These lads are definitely allocated to a shop where they can be given such a thorough training in their selected trade, that they will be fully qualified tradesmen on the termination of their course.

The number of approved trades in the Ordnance Factories is a large one, and is in itself evidence of the varied activities of these national workshops. Among them may be mentioned armature winder, boilermaker, borer, bricklayer, carpenter and joiner, coppersmith, electrical fitter, fitter, instrument maker, miller (universal), millwright, moulder, painter and signwriter, patternmaker, plasterer, plumber, smith, sheet-metal worker, turner, wheelwright, wireman. Obviously it would be impossible to describe the practical training arranged for these different trades, and two cases will be cited as typical. A fitter apprentice is given a complete course of fitting and general bench work, and, in addition, nine months of his time are devoted to shaping, milling and drilling, while towards the close of his course it is arranged that he shall have experience in erecting.

A patternmaker apprentice, as well as being put on the bench and given all the necessary instruction in handicraftsmanship, spends part of his time on the various machines incidental to his trade, and is given six months in the foundry, so that he may have an opportunity of acquiring the moulder's point of view.

The theoretical training of trade apprentices has to be obtained at evening institutes, which furnish periodical statements as to the progress of these lads. If the report on any boy is unsatisfactory, his apprenticeship may be summarily terminated.

The course of study is that considered most appropriate, and is varied to suit the requirements of the trade on which the lad is engaged, but the final selection of subjects must meet with the approval of the apprentice supervisor, to whom allusion will shortly be made.

Engineering Apprentices.

As has already been mentioned, the engineering apprentice begins his career by a success in an open

competitive examination, and a few words as to the nature of the examination are probably desirable. As competition is keen, a number of the applicants have very little prospect of success, and a preliminary examination is held for the purpose of eliminating the impossibles. This examination is of an elementary character, and includes only two subjects :—

(1) English, comprising (*a*) writing to dictation ; and (*b*) essay writing ; and
(2) Arithmetic and algebra ;

the latter being of a simpler character than in the examination proper.

The lads who obtain a qualifying percentage of marks are then allowed to proceed to the second examination, which embraces the following subjects :

(1) Mathematics.
(2) Elementary physical measurements and applications.
(3) English, of a general character, but also including questions involving a knowledge of history and geography. Questions are also given on a set book (" Oliver Twist " for 1925).
(4) Drawing.

Candidates who have satisfactorily passed this examination are then examined *viva voce*, to test their general intelligence and observation, and are also given a few simple tests in practical measurements, &c. The examination for " B " candidates is of a higher standard, and includes general physics, and an optional subject which is either a modern language or higher mathematics.

After the apprentices have been selected, their theoretical course takes the form of day classes at the Woolwich Polytechnic—or in the case of lads in the Royal Small Arms Factory, Enfield, at Ponders End Technical Institute. They attend for about three half-days a week during term, and are given their full wages for the time they are engaged on their class work.

In an article of this nature it would not be possible to set out the full syllabus, but on the completion of his course an apprentice of fair average ability should have reached the standard of the Intermediate B.Sc. (Engineering). As an indication of the ground covered, the third-year course may be given as typical, and the following is the curriculum :—

Mathematics.—Binomial Theorem and Expansions. Trigonometrical formulæ. Vectors and complex quantities. Differential coefficients. Maxima and minima. Taylor's and Maclaurin's theorems. Integration by substitution, by parts, and by partial fractions. Areas, centres of gravity and moments of inertia. Applications to problems in engineering, mechanics and physics.

Geometry and Machine Drawing.—Geometrical properties of ellipse, parabola and hyperbola. Enlargement of geometrical figures. Centre of gravity. Descriptive geometry of point and line. Traces, true length and inclination of a line. Oblique planes. Intersection of and angle between oblique planes. Development of surface of solids. Interpenetration of simple solids. More advanced measuring up and drawing to scale of machine and engine parts. Calculations on stresses in bolts, riveted joints, &c. Elementary design.

Engineering Science.—Lectures and Laboratory Work. Tensile and compressive stresses. Modulus of elasticity. Poisson's ratio. Shear stress. Shear modulus. Tension test, elastic limit, yield point, maximum stress, extension, contraction of area, &c. Extensometers. Thin shells. Riveted and pin joints.

Beams. Shearing force and bending movement with diagrams. Revision of conditions of equilibrium. Polygon of forces. Link polygon. Relative motion. Angular velocity and acceleration. Kinetic energy of rotation. Fly-wheel. Centrifugal force. Simple harmonic motion. Governors. Balancing in one plane. Slider crank chain, displacement, velocity and acceleration.

Use of steam tables. Heat to generate steam. Working of heat engines and boilers. The indicator. Indicated horse-power. Cylinder, condensation, jacketing and superheating. Slide valve, simple valve diagrams. Fuels. Combustion.

Magnetism and Electricity.—Lectures and Laboratory Work. Properties of magnets. Simple phenomena of magnetic moments. Magnetic field. Lines of force. Law of force. The earth as a magnet.

Simple cells. Action of current on a magnet. Galvanometers. Electromotive force. Resistance. Ohm's law. Electrolysis. Voltameters. Electro-magnetic induction. Secondary batteries.

Electrostatics. Conduction and insulation. Quantity of electricity. Distribution on a conductor. Some applications of electricity, *e.g.*, lighting, power, telegraphy and telephony. Electric methods of measuring temperature.

In the fourth year the students concentrate on more advanced mathematics, engineering science, and electrotechnics.

Apprentices are expected to obtain a high standard of efficiency, and those who fail to obtain 65, 60, 55 and 50 per cent. in the four years respectively are liable to have their names removed from the list of engineering apprentices.

Fees amounting to about 20s. a year are payable by the apprentice, but most of the money so paid is refunded if progress has been satisfactory.

The practical course in the workshops has been arranged to give a thorough training in as general a manner as possible, and is normally divided as follows :—

Fitting and erecting (including millwrighting and maintenance work)	18 months
Turning (including general machine work)	18 ,,
Drawing-office	6 ,,
Patternmaking, Foundry, Smithy, Mechanical testing	12 ,, (usually in about 3 month periods)

As the length of apprenticeship varies, owing to the different ages of entry and a fixed age for completion, the time in the different sections has to be modified slightly, while, in addition, lads showing signs of particular ability are sometimes given a special opportunity to spend time in some of the administrative departments, *e.g.*, estimating, ratefixing, production.

Prizes are given annually on the results of the year's work, both practical and theoretical.

Student Apprentices.

Student apprentices, having obtained the theoretical part of their training at a university prior to admission to the factories, devote the whole of their three years to the workshop side. The prescribed course is as follows :—

Turning and machine work	12 months
Fitting, erecting and millwrighting	12 ,,
Patternmaking	3 ,,
Moulding	3 ,,
Smithing	3 ,,
Drawing-office	3 ,,

The course being occasionally modified somewhat to meet individual requirements.

All grades of apprentices are governed by the ordinary rules of the factory, and are expected to work the usual hours, which are ordinarily (for Woolwich) 8 a.m. to 1 p.m. and 2 p.m. to 5.40 p.m. Monday to Friday, and 8 a.m. to 11.40 a.m. on Saturday. It is felt that the value of participating in the ordinary shop discipline cannot be too strongly emphasised.

All apprentices receive wages during the whole of their course, the trade apprentice being paid according to his age from a rate of 8s. at the age of 14 to 22s. 6d. at the age of 20, to which must be added the industrial bonus, bringing the total wages to 13s. and 36s. respectively at the present time.

Engineering apprentices are paid 10s. a week (or 16s. with the present bonus applied) during their first year, with annual increments of 2s. to the base rate for the second and third year, and then 2s. 6d. for following years of their course.

Student apprentices are paid 20s. per week for the first year, and 25s. and 30s. respectively for the two succeeding years, and again a cost of living bonus, at present standing at 15s. per week is added.

On the satisfactory completion of the course, certificates are given to the apprentices.

Having thus briefly outlined the scheme itself, the method of operation next claims attention.

The Apprenticeship and Training Board.

From the outset it was decided to do everything possible to ensure that all apprentices were given equally favourable opportunities, and to eradicate even the suspicion of favouritism. To do this, an Apprenticeship Board has been appointed to operate the scheme on behalf of the Chief Superintendent of Ordnance Factories (and the Superintendent of Enfield). The Board consists of some of the heads of departments, those who have been particularly interested in the training of youths, representatives of the shop stewards, as it was realised that the goodwill of mechanics and workers generally was essential if smooth working was to be obtained, and the Apprentice Supervisor. Normally, the Board meets about once a month, and considers all matters scholastic and practical connected with the apprentices.

A small standing committee, consisting of selected members of the Board, known as the Interviewing Committee, investigates the applications for student apprenticeships, and also periodically interviews lads who have failed to obtain the required standard in their class work, or who may have had adverse reports from the workshop. By patiently listening to the statement of the lad, and by giving him suitable advice before he has failed irretrievably, much good has resulted, and several cases have occurred where lads have shown a very marked improvement, and it has been the pleasant duty of the Committee to congratulate them on their attainments. Great stress is laid on the value of homework as an indication of the application of an apprentice, and when it is seen that although the examination results are not as good as might be expected, the percentage for homework is very high, the Committee is sure to view the case more leniently than that of a lad who has done tolerably well at his examinations, but has evidently devoted very little attention to his homework. Reports are obtained from the Polytechnic on the progress of the lad at the end of each term—*i.e.*, three times per annum—or more frequently in the case of lads whom the Board may particularly desire to watch, *e.g.*, lads who have been warned and then allowed to continue apprenticeship, provided they give evidence that they are making the necessary effort. Lads who have done satisfactorily generally and yet are weak in one or more subject are seen, with the object of investigating their difficulties, and, if possible, extending some help. Apprentices who have done well are not neglected, indeed everything possible is done to prove that interest is being taken in every one.

Special committees are appointed from time to time to deal with matters that require special investigation, in order to save time when the question is considered by the full board.

Apprentice Supervisor.

A very important factor in the operation of the scheme is the apprentice supervisor, an official whose whole time is devoted to the care of the apprentices. He is responsible for all the records that are kept as to progress, &c.; he arranges with the management the necessary shifts from shop to shop as they become due, and is responsible for the instruction given to the apprentices, keeping an eye upon them all, ever ready to give advice, often unasked, and seeking to sound the necessary note of warning at the appropriate moment, and to speak the occasional word of approbation, so frequently a source of help and inspiration to the young man. Thanks to his good offices, many a lad has been saved from having to give an account of his failings to the interviewing committee of the Board. When it is mentioned that this official has upwards of three hundred apprentices in his care it will be readily admitted that the post is no sinecure. He also arranges at suitable intervals visits to engineering works within reasonable access, the apprentices only having to pay their own fares, as nothing is deducted from their normal pay for the hours they lose from work. These visits have proved very useful, not only on account of their direct educational value, but also for the way in which they help to widen perspective. Visits have been made during the past year to Messrs. Fraser and Chalmers, the Western Electric Company, the Associated Equipment Company, and J. and E. Hall, and others are in prospect, return visits to Woolwich being welcomed.

Record Keeping.

It is no easy matter to obtain reliable reports as to progress from foremen and others concerning the apprentices that are temporarily in their care, for the standards set by the different officials vary considerably, and it is only by careful consideration on the part of the apprentice supervisor, not only of the lad in question, but also of the foreman making the report, that strictly comparable results are maintained. Reports are made monthly by the factory on a special form, all apprentices in the shop or section being shown, and these reports are passed to the apprentice supervisor, who finds them extremely useful in the preparation of his own records.

He keeps a separate card for every individual, and these cards are slightly different in character to meet the requirements of the three grades of apprentice. Whenever a lad is interviewed his card is called for ; it is used when his apprenticeship certificate is being prepared, and it is also useful when the advisability of retaining an apprentice on completion of his course is being considered, or in case of a proposed promotion to a position on the staff.

Apprentices' Association.

Although not part of the apprenticeship scheme, considerable help is given by an active and useful association formed by the apprentices themselves, all grades being included, although it was originally started by the engineering apprentices. A club room has been allotted to them in which to hold their meetings, and they arrange a very interesting programme of events. Heads of departments are invited to lecture now and again, and the apprentices evidence a keen perception of the problems that are incident to factory administration. They do not neglect the social side, organising dinners, dances, &c., and altogether the association serves a very useful purpose and is a great help in developing the personality of its members. Membership is voluntary, and all the management is in the hands of the apprentices themselves, who, however, can rely on the help and encouragement of the Apprenticeship Board. A very creditable magazine of about forty pages is published by the association about three times a year, and is in itself a very effective link between ex-apprentices and the present generation.

Conclusion.

In conclusion, it should be emphasised that every endeavour is made to turn out fully trained men, qualified both practically and theoretically, self-reliant, and capable of making their way in the world. No artificial barriers are set up, no hard-working lad need feel that his horizon is limited, or that he has not the opportunity of attaining to the highest position, and even the suggestion of favouritism on the part of the staff has been eliminated as far as is humanly possible. Although the revised scheme of apprenticeship is in its infancy, indications are not lacking to show that it has come to stay, and that it will give satisfactory results to the benefit both of the individual and of the State.

A conference of the leading European broadcasting authorities, convened by the British Broadcasting Company, met in London a few days ago for the purpose of examining ways and means of co-ordinating and developing wireless broadcasting through agreement between the broadcasting authorities of the countries concerned. All the principal broadcasting authorities on the Continent were represented, directly or by agents in London. In a statement on the proceedings, the British Broadcasting Company says that at the first morning session the whole field was explored, and the various delegates pooled both their difficulties and their requirements. It was agreed in principle to establish an International Bureau to perform the double function of a clearing-house of information and an instrument for the adjustment of technical difficulties of an international character. The preliminary deliberations disclosed a complete unanimity of opinion on the responsibility imposed on those charged with the administration of broadcast services, particularly in the direction of fostering international goodwill.

New Ironfoundry at a Sheffield Works.

On the occasion of the opening of the new Darnall Works of Davy Brothers, Limited, of Sheffield, on June 20th, 1921, it was explained that the medium and light machine shops set to work at that time comprised one unit only of an engineering establishment, and that it was intended to complete the works as circumstances and conditions permitted. An approximate plan of the complete works appeared in the issue of The Engineer for June 24th of that year. A large ironfoundry has now been constructed. It is arranged on the most modern lines for the production of a varied class of work of a non-repetition character, comprising castings up to, say, 40 tons weight, or even heavier if required. The buildings comprise a main bay, a light bay and lean-to, and a large stockyard area. An external view is given of it in Fig. 1.

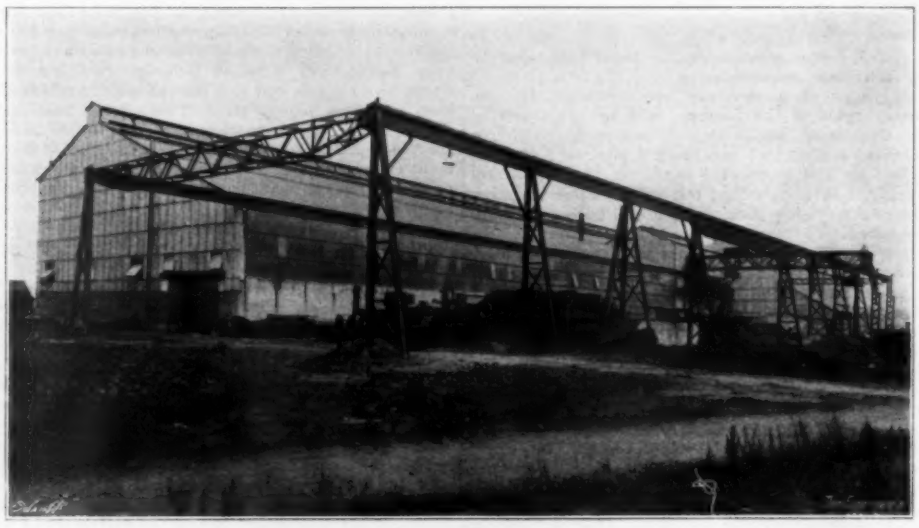


FIG. 1—EXTERNAL VIEW OF THE FOUNDRY

Buildings.—The buildings are of steel framework, supplied by Redpath, Brown and Co., Ld., the lower part of the walls being of concrete with "Trafford" tiles above. They are very spacious and particularly light, and as will be gathered from the illustrations, which are given herewith and on page 382, more than half of the roof area is of glass, while side lighting, consisting of Mellowes "Eclipse" lead glazing, is provided for the core department and sand plant. The artificial lighting arrangements are also on an extensive scale, comprising, as they do, 30 1000-watt and 28 500-watt lamps and reflectors. The contrast, therefore, both by day and by night, as compared with the greater proportion of existing foundries, is striking.

Main Bay.—The main bay is 390ft. long with a crane span of 60ft. and a height to crane rails of 30ft. It is provided with three electric overhead travelling cranes, one 40-ton by S. H. Heywood and Co., Ld., one 25-ton by Royce, Ld., both fitted with a 5-ton auxiliary hoist, and one 15-ton by J. Adamson and Co., Ld. Provision has also been made for a future 60-ton crane. Further, in order to leave the overhead cranes free for heavy lifts and to obviate possible delay in waiting for them, 10 jib cranes, which are each capable of lifting 3 tons at a radius of 20ft., are attached to stanchions at various points round the shop. These jib cranes are provided with motors for lifting and lowering, while the racking and slewing is done by hand. A point worth noting is that the gears of all the cranes in the foundry are totally enclosed so as to keep out dust.

An excellent feature of the handling facilities is the provision of a 1-ton 2-motor electric transporter or telpher, by S. H. Heywood and Co., Ld., which is arranged to travel completely round the main bay, except for one end, and is fitted with a grab for transporting sand from the sand plant near to any point required in the foundry, and also to points at which it can be delivered into special hoppers serving the core department and light foundry. The grab of this transporter is of the Priestman improved combined hand and self-dumping type, arranged to discharge by hand on the operation of a cord when it is suspended, or automatically on coming to rest on the ground or heap. The heaped capacity of the grab is 12 cubic feet, the flush capacity 10 cubic feet, and the weight when empty 10 cwt. The main bay is shown in Figs. 5 and 6 on page 382, the former of which shows the casting pits, sand plant and telpher, while the latter shows the cupolas, charging platform and stoves.

Light Bay.—The light bay is 120ft. long with a crane span of 60ft. and a height to crane rails of 25ft. It is provided with one 10-ton electric overhead travelling crane of the 3-motor type, by Royce, Ld., and also with four jib cranes, which are attached to stanchions at various points, and which are each capable of lifting 1 ton at a radius of 20ft. This bay is shown in Fig. 2.

Lean-to.—The lean-to is 210ft. long with a crane span of 30ft. and a height to crane rails of 22ft. 6in. It comprises the pattern-receiving floor, the sand treatment plant, and the core department, and it is provided with one 2-ton electric overhead travelling crane, by Royce Ld.

Stockyard.—The stockyard—which is shown in Fig. 3—is of large dimensions, the area covered by the crane being 300ft. by 70ft., the crane span 70ft. and the height to crane rails 28ft. 6in. It is provided with one 20-ton electric overhead travelling crane, by Royce, Ld., which is fitted with a 5-ton auxiliary hoist. A "Phœnix" patented electro-magnet is also provided to enable this crane to handle pig iron from the truck to the storage bins, and from the latter to the service bins upon the charging platform. The magnet is of circular shape, 52in. diameter, and is capable of lifting 1 ton of pig iron. It is wound for 220 volts direct-current, and is controlled by a set of "Phœnix" contactor gear. Further, to enable this crane to handle sand, it is equipped with a "Priestman" combined hand and self-dumping grab, which is, like the grab of the telpher in the foundry, arranged to discharge by hand on the operation of a cord while suspended, or automatically on coming to rest on the ground or heap.

FIG. 2—THE LIGHT BAY

Handling of Iron and Coke.—The handling of the pig iron can be clearly seen from Fig. 3. The iron is delivered in quarter pigs, and the trucks in which it is contained run on a rail track alongside the storage bins, of which there are six, so that the iron can be kept separate according to brand, and which are built of concrete lined with wood. The magnet is also used, as shown in the engraving, for transferring the pig iron when required to the service bins on the charging platform. Actually, the illustration shows full pigs on the magnet, but generally, as already mentioned, quarter pigs are handled. The coke is unloaded from trucks and is delivered on to the charging platform by the same crane, a skip fitted with lifting hooks, which can be raised up by the crane and deposited on the charging platform, being employed. This illustration also shows the scrap breaking pit, which is of concrete lined with sleepers, and the breaking ball. The latter, by the way, is quickly and easily handled by means of the magnet. At the back of the picture can also be seen the pits by means of which the residue from the cupolas is removed as described later.

Cupolas and Charging Platform.—The cupolas are four in number, of the following dimensions and capacities :—

Diameter of shell. Inches.	Diameter of lining. Inches.	Melting capacity per hour. Tons.
72	54	10 to 12
56	38	7
46	32	3½ to 4
41	29	2

They are of the usual Whiting type, fitted with drop bottoms and were supplied by J. W. Jackman and Co., Ld. There are pits under the cupolas, which are connected by tunnels provided with rail tracks underground leading to the pits outside in the stockyard, mentioned above. At the end of the blow, the bottom of each cupola is dropped, and the remainder of the charge is deposited into a skip mounted on a slag bogie. This bogie is pulled through its tunnel out to the stockyard pit, where the skip, which is fitted with trunnions, is lifted out by a beam and sling bars on the yard crane, and its contents dumped on the waste heap. One of the cupolas is provided with a swivel pouring spout, so that hot metal can be supplied to either the main or light foundries, as required. The fan room, which is situated under the charging platform, measures 30ft. by 14ft. by 12ft. high. Each cupola is arranged to be blown by a separate fan, but there is a stand-by fan which can blow any one of the three smaller cupolas in case of emergency. The fans comprise the following :—(*a*) One type N No. 6 high-pressure fan, by the J. Keith and Blackman Company, Ld., having a cast iron housing, with 12in. diameter flanged outlet, a mild steel impeller 40in. diameter, and a cast iron bedplate extended to receive the motor. The motor driving it is capable of developing 40 horse-power when running at 1450 revolutions per minute, and the fan, which is designed to deliver 6000 cubic feet of air per minute at an outlet pressure of from 24in. to 25in. water gauge (total), absorbs 36 horse-power. (*b*) Two No. S 4 fans, by the same makers, which are similar to the foregoing, but have 8in. diameter outlets and 20in. diameter impellers. Each motor can develop 20 horse-power when running at 2900 revolutions per minute, and each fan when delivering 2500 cubic feet of air per minute at an outlet pressure of 25in. water gauge (total) takes 15.7 horse-power, or, when delivering 3000 cubic feet per minute at the same pressure, 19 horse-power. (*c*) One No. S 5 fan, by the same makers, with 10in. diameter outlet and 24in. diameter impeller, the motor being of about 20 horse-power; and (*d*) one No. 9 duplex fan, by Alldays and Onions, Ld., with a 26 horse-power motor, which is the standby fan.

The charging platform, which measures 60ft. by 36ft. and stands at 20ft. above ground level, is constructed of reinforced concrete, and is continued over the stoves to act as a coke store. This platform is illustrated in Fig. 4, on the right-hand side of which are seen the service bins, six in number, which contain the various brands of pig iron and scrap. A short rail track which runs along the open ends of these bins, is arranged at a level several feet below that of the bin so as to obviate any lifting of the pigs, which are only pulled forward by a hand hook and then

dropped by hand into the charging skip. This skip is carried during loading, on a special bogie with a pocket to receive it, and a 2-ton weighing machine by Hy. Pooley and Sons, Ld., is embodied in the bogie for weighing the charge. This weighing machine has a dial with four movable indicators arranged circumferentially, so that they can be set to the different weights required, and that the loading men have only to throw the materials into the skip until the main pointer reaches the different circumferential indicators, which make the loading of the required weights easy and rapid. A taring steelyard is provided for the skips. The bogie is operated by means of motor haulage gear from a controller on the bogie.

The charging crane, which is of the overhead underhung jib type, by S. H. Heywood and Co., Ld., has a capacity of 2 tons. It has an extra barrel for operating the skip discharge. The skips, which have drop bottoms, can be discharged into any one of the four cupolas. The design of the skips has been modified in accordance with Messrs. Davy's experience, and the type now employed, which has given complete satisfaction, is transported, when loaded, by means of the crane rope attached to the drop bottom, further ropes being attached to the skip on each side. When over the cupola the central rope is lowered, and as the skip is then held by the side ropes, the bottom is opened by the weight of the material it contains and the charge is deposited without any risk of sticking.

Casting Pits.—For casting long cylinders, rams, &c., on end, the main bay is provided with casting pits built of concrete, as seen in the foreground of Fig. 5, page 382. The area of the pits is 27ft. by 18ft. and the depths 7ft., 10ft. and in the case of an 8ft. square portion 25ft. deep.

Core Department.—The core department is situated in the lean-to adjoining the stoves, and measures 70ft. by 30ft., and 22ft. 6in. high to crane rails. It is served by the 2-ton overhead crane mentioned above. There is also a jib crane which is capable of lifting 3 tons at a radius of 20ft., and is arranged to swing round into the main bay so as to deposit the larger cores on bogies to transport them to the drying ovens. The core benches are constructed of cast iron plates machined on the upper surface. There is a small core stove 8ft. by 8ft. by 8ft. inside dimensions.

Drying Stoves.—The drying stoves, which are all provided with rail tracks for charging by means of bogies, comprise the following:—Main bay: One stove, 28ft. 8in. long by 17ft. wide by 10ft. high; one stove, 28ft. 8in. long by 10ft. 6in. wide by 10ft. high; one stove, 28ft. 8in. long by 12ft. 4in. wide by 12ft. high. Light bay: Two stoves, 18ft. long by 12ft. 6in. wide by 9ft. high. Core department: One stove, 8ft. long by 8ft. wide by 8ft. high—all inside dimensions.

The stoves, which were supplied by August's Muffle Furnaces, Ld., are built in accordance with the most modern ideas, and there is a separate furnace or fire-box for each stove, so that one or more stoves may be used as required for the work in hand, without firing for the whole installation. The old type of drying stove heated by means of a local fire inside the oven or by a combustion chamber inside the oven and fed from a producer is not efficient, seeing that it is constructed merely to attain a certain temperature in the stove, and temperature alone is not, of course, sufficient for satisfactory drying. For the stoves under consideration the fire-boxes are placed in a pit, which is totally enclosed and below ground level. This arrangement is, Messrs. Davy maintain, more efficient and economical, seeing that it permits of better control of the products of combustion, which is more successfully effected when the position and design of the fire-box is such that the heated gases rise naturally to the point where they are required. Air is blown into the pit by a low-pressure fan, and its flow through the installation is controlled by the means of primary air ports, which are arranged by the side of the ashpit, and by air regulators through the furnace door over the fire. Auxiliary air also passes through chequer work in the walls of the fire-box, and enters the main supply flue for the ovens without having come in contact with either the fuel or the gases. The air supplied in this way tempers the products of combustion to a reasonable and safe temperature for drying, and at the same time provides an adequate and continuous supply of dry atmosphere capable of absorbing moisture, and holding it until it has passed entirely from the installation, *viâ* the exhaust or chimney. This gives a slight pressure in the ovens. The dry warm atmosphere makes uniform drying a certainty, and gives not only a larger and more economical output, but ensures better work. The atmosphere is admitted into the stoves from the main flue at the back by means of regulator dampers, and is exhausted into the depressed floor and finally through the flues into the chimney.

The depressed floor, which is built on a new system recently patented by Mr. H. M. Lane, of Detroit, U.S.A., constitutes a very considerable improvement on previous arrangements. The hot gases passing into the chamber collect or absorb, during the early stages, a very large percentage of moisture and this moisture considerably increases the weight, so that the saturated atmosphere falls to the bottom of the stove mostly to the centre. By means of the depressed floor the heavy atmosphere immediately leaves the oven and is replaced by hot air, so that the operation of drying is not retarded and condensation on the sand structure is entirely avoided. The doors of the stoves are of the August patented insulated type, high-class insulating material being interposed between the inside and outside doors, which are suspended with wire ropes and balance weights, the shaft hanging in ball bearings so that one man can easily manipulate the doors. Two portable mould dryers, also supplied by August's Muffle Furnaces, Ld., each complete with fan and motor, are employed for moulds which have to be dried in place.

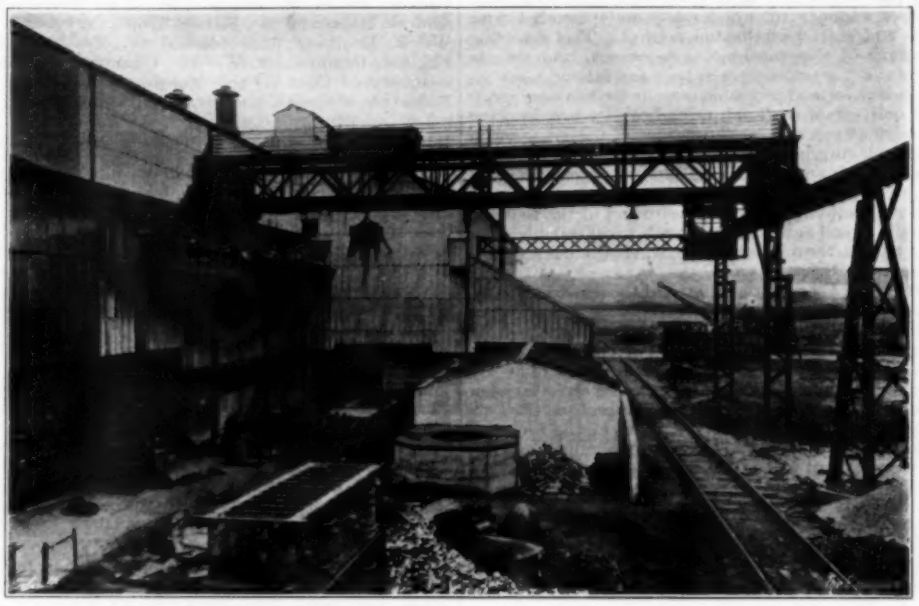


FIG. 3—STOCKYARD AND PIG IRON HANDLING PLANT

FIG. 4—CUPOLA CHARGING PLATFORM

Sand Treatment Plant.—A complete and efficient plant has been installed for the treatment and handling of sand. It is designed to deal with 5 tons of facing sand per hour, though it is capable of a considerably larger output of sand which merely requires reconditioning. It is arranged for automatic operation except in the case of the feeding of the new and old sand on to the elevator, for which the services of one man only are required. New sand is lifted from the railway wagons on the stockyard track by means of a "Priestman" grab on the stockyard crane and deposited into two reinforced concrete hoppers in the stockyard. These hoppers are built up to the foundry wall and open inside the building close to the sand treatment plant. The black or used sand returned from the foundry is also delivered to the same point by means of a belt conveyor fed from a steel storage hopper which has a shaker feed. This conveyor delivers on to a No. 3 "Vulcan" return-feed sand sifter made by J. W. Jackman, Ld., which is of the reciprocating type, with a 60in. by 36in. sieve, and which discharges the riddled sand conveniently for mixing with a suitable proportion of new sand, coal dust, &c. The storage bin for used sand is charged by a "Priestman" grab carried on the overhead transporter which travels round the foundry, and this grab also conveys the prepared sand to the moulders.

After the sand has been mixed in the required proportion on the floor, it is taken up by means of a chain bucket elevator, which delivers into a standard overdriven type roller mill, made by J. W. Jackman and Co., Ld., which has a 7ft. diameter pan fitted with rollers 42in. diameter and 13in. face, arranged on an elevated structure. The sand is delivered from this mill into a 30in. sand mixer of the double revolving reel type, made by C. E. V. Hall, from which a belt conveys it into one of three storage bins, or, alternatively, on to a transverse conveyor arranged to feed the other two of these bins. These three bins are situated under the transporter mentioned above, and will be seen in Fig. 5, page 382. The transverse conveyor is so placed that it can be made to deliver into a second roller mill of the same type and make as that just described, which is used for preparing loam. The plant is so arranged that by means of an adjustable chute, the first mentioned roller mill can be cut out and the sand delivered direct into the mixer and thence to the storage bins. The sand elevating and conveying equipment was supplied by the Paterson Hughes Engineering Company.

The two roller mills and mixer are driven through belts from a 30 horse-power electric motor, whilst two 3 horse-power and one 4 horse-power motors operate the conveyors and riddle. A contemplated future addition to the plant is a mechanical shake-out for boxes combined with a screen and magnetic

separator, which would deliver sand under the transporter to be picked up and dumped as required by the moulders.

Moulding Equipment.—As the castings generally being handled at present are of a varied class with very little repetition work, no moulding machines have so far been installed, but a special feature of the equipment is a portable type "Beardsley-Piper" sand slinger, made by Foundry Plant and Machinery, Ld., of Glasgow, which can be seen in Fig. 5, page 382, and which is used for the larger moulds. This machine is capable of riddling and ramming sand at the rate of 7 to 10 cubic feet per minute, and can deal with any size of mould. It is fitted with totally enclosed motors and control apparatus, and provided with stop and start push-button control. The moulding capacity of this machine is enormous, and its use effects very great savings in time and labour.

General.—Good provision is made for the easy entry and delivery of material, a roadway leading into the foundry at one end for the receipt of patterns, and a rail track entering about the middle for the moulding boxes, which are drawn in and out on bogies operated by an electric capstan having a positive drive in either direction. At the opposite end of the foundry there is a road across the end with a rail track leading directly into the machine shops, where there is a weighbridge.

From the above description and the illustrations we reproduce it will be realised that the workman carry out their duties under conditions very different from those which have been associated with some foundries of the past. Instead of the depressing effect of poorly lighted buildings with low roofs, there is an impression of space and light which grows as it is realised that the same conditions prevail in all parts of the foundry. The better conditions and brigher surroundings cannot, we imagine, fail to be beneficial to the workpeople. At the same time the arrangement of the plant and the modern handling facilities provided should be conducive to production on the most economical lines.

The works manager, Mr. C. A. Mills, was responsible for the design, lay-out and supervision of construction, and he was ably assisted by the works staff.

Institution of Naval Architects.

No. I.

The annual meetings of the Institution of Naval Architects opened at the Royal Society of Arts on April 1st, under the presidency of the Duke of Northumberland.

The annual report of the Council was presented, and we learn from it that during the past year a net loss of fourteen members has been sustained. Despite the continued depression in the shipbuilding industry, there was an increase of 143 in all classes of membership, but this gain was more than made up by the loss of 157 members by death and resignation during the same period. The Council has received numerous expressions of warm appreciation from foreign guests who attended the joint summer meeting with the Scottish and North-East Coast Institutions. A statement of receipts and expenditure shows a satisfactory financial position. The research work at the Froude Tank continues to progress, but funds are needed to carry on the work. Shipowners, through the Chamber of Shipping, have agreed to renew their contribution of £1000, and an appeal for support has been made to shipbuilding and marine engineering firms. A sum of £5000 per annum is needed, towards which the Government Department of Scientific and Industrial Research would, under certain circumstances, be prepared to contribute one-half, provided the balance was raised by the industries interested. A report of the Skin Friction Committee has been received and will be printed in the "Transactions." The Committee expresses the opinion that the knowledge of skin friction would be furthered by tank experiments, although for framing ship estimates a considerable extension of the data so obtained would be required. The majority of the Committee is of the opinion that the additional data could be furnished by towing a destroyer hull, and thinks that the fairly serious outlay would be justified by the results; but in view of the existing trade depression it is not thought expedient to take further steps which might involve considerable expenditure. A gold medal was awarded by the Council to Engineer-Commander R. Beeman, R.N., for his paper "Further Experimental Work on Diesel Engines," and a premium to Professor K. Suyehiro, D.Eng., for his paper on "The Drift of Ships Caused by Rolling Among Waves." Both these papers were contributed to the 1924 meetings.

In accordance with a resolution passed at the annual general meeting in 1921, the Council has prepared certain amendments to the rules for the election of members and associate members, which seek to raise the standard of qualification. These amendments will, if approved by the annual meeting, take effect in 1926. The following representatives of the Institution on other bodies have been elected:—Engineering Joint Council, Sir John H. Biles and Sir Archibald Denny; Board of Trade Merchant Shipping Advisory Committee, Sir Thos. Bell and Mr. J. T. Batey; British Engineering Standards Committee: Main Committee, Sir William E. Smith; Varnishes Committee, Mr. R. Williamson; British Corporation Registry Main Committee, Engineer-Commander W. N. Wisnom, R.N. (Ret.), and Mr. A. W. Sampson; William Froude Tank Advisory Committee, Mr. H. G. Williams; Court of Sheffield University, Sir Charles Ellis.

It was announced that the Duke of Northumberland had been re-elected president and that the ballot for vice-president and members of Council had resulted as follows:—Vice-president, Mr. W. J. Berry; members of Council, Mr. G. S. Baker, Mr. T. Carlton, Mr. W. H. Dugdale, Mr. John Gravell, Mr. Andrew Hamilton, Mr. Robert Traill, Professor J. J. Welch, Engineer Rear-Admiral W. M. Whayman, Engineer-Commander W. M. Wisnom; associate members of Council, the Marquis of Graham, Sir Robert A. Hadfield, and Mr. J. Herbert Scrutton.

The Duke of Northumberland, in opening the session, said that the meeting was taking place at a somewhat critical time in the history of British shipbuilding. To the Institution belonged the credit of having ensured the welfare of the shipbuilding industry in a very eventful epoch. During its sixty-five years of existence naval architecture had witnessed many changes in shipping and shipbuilding, the key industries of the British Empire, and there was reason for confidence that these industries would overcome the difficulties with which they were confronted as successfully as those of past years had been surmounted. It would, however, be folly to underestimate those difficulties. There was not only the keenest competition from foreign countries, but unprecedented labour difficulties at home. The whole question of British maritime predominance was now causing the gravest anxiety to the nation. There was no need to dwell upon the facts which had been brought out by the recent shipbuilding returns. In the great shipbuilding centres the absence of orders had brought widespread distress to the working population, and many firms were looking anxiously for signs of a change in the ebbing tide of their fortunes. Shipowners were unable to place orders with home yards at satisfactory prices and vessels were being ordered elsewhere.

The recent placing of an order for five large motor vessels for British shipowners with a German yard had aroused a feeling which, without exaggeration, might be described as one of consternation. The Navy Estimates, which usually carried promises of additional orders, this year provided little comfort for British shipbuilders. For the first time no provision was made in them for a vote for new construction, although there was the prospect that before many months were over some additional cruisers would be ordered. It was difficult in the meantime to tide over the further protracted period of unemployment.

What was happening in the shipbuilding industry was happening, to a greater or lesser extent, in most of the great industries of the country, notably in coal mining and the steel and iron industries. That was not the occasion for entering into a detailed examination of the causes which had produced this state of affairs, causes which had rendered the cost of production so high that Great Britain could not compete with other nations. During the past few years a great deal had been heard about the necessity of putting Germany on her feet and of the benefits which this country would derive from that policy. Germany, by the manipulation of her currency, had succeeded in paying off her own war debts, while avoiding the discharge of any but a comparatively small portion of her reparation payments. British capital which had not been available for financing British industry had flowed instead into Germany. She had restored her currency and had equipped her shipbuilding yards and her factories with the most up-to-date machinery, and had thus been able to enter a course of competition which was ousting Great Britain from her own markets and depriving her of her trade. Wiser men than he had confidently predicted that the policy of putting Germany on her feet would be of immense benefit to this country. He could only try to believe and to hope, increasingly difficult as it was to do so, that that was a true estimate of the position. The principal factor in the high cost of production was, of course, the high rate of wages. The wages of skilled men in German shipyards, for instance, were recently given as 33s. 6d. per week, compared with 56s. 8d. for the British workman; while the hours were fifty-four per week, as compared with forty-seven in this country. For unskilled labour the German wage was 30 per cent. below the British wage. The situation was rendered worse by the rigidity of British trade union rules as compared with those of foreign trade unions. The result was not only that our industrial supremacy was menaced by foreign countries, but that we had about a million unemployed.

Many proposals had been made for dealing with that situation, and it had frequently been pointed out that something must be wrong with a system which had caused the State to spend something like £300,000,000 since the Armistice in unemployment doles when that sum might have been expended in keeping men on productive work. It would really seem that the proposal lately made by such authorities as Sir Alfred Mond and others, whereby the Government should subsidise industry to the extent of the dole, deserved more examination than had hitherto been given to it. Such a course would enable British industry to meet foreign competition on favourable terms and might at least tide over the present crisis. Another remedy which also seemed to require more investigation was that of reducing the burden of taxation and of rates, which was crippling so many British firms.

There was at least one cheering feature in the situation, and that was that its seriousness was now realised by all concerned and especially by those engaged in the shipbuilding industry. The meetings that had taken place between employers and employed showed that there was a general realisation of the fact that co-operation between all concerned in the industry was essential if that industry was to be saved. An eminent statesman recently remarked in the House of Commons that it was no use saying "Little children, love one another if some children had all the toffee and other children had none." What that observation meant he was at a loss to understand. If it meant that there could be no real co-operation between employers and employed so long as there were rich and poor, it was a counsel of despair, because inequality of wealth must always exist in this world. If it meant that the employer was getting an undue share of the profits of industry, it was palpably untrue, especially in regard to the shipbuilding industry.

Whatever the solutions of these problems might be, it was quite certain that no remedy could succeed without a real sense of the community of interest between all those engaged in the industry and a united effort to overcome the obstacles which now threatened its prosperity. One of the greatest difficulties was that of the difference between the wages of the sheltered and unsheltered trades, which resulted in the anomaly that a road sweeper received a higher remuneration than a skilled mechanic. The immediate effect of such an anomaly was shown in the disinclination of students to enter for scholarships or to follow such higher technical classes as were available. Yet the need for research and for training by scholarships by those who were to carry on research that would lead to improvements in industrial methods was absolutely essential to industrial expansion. There was no better testimony to the value of research in those problems which confronted the naval architect than the "Transactions" of the Institution. William Froude's investigations on ship resistance, which were so ably followed up by his son, the late Dr. R. E. Froude, and more recently by Mr. G. S. Baker at the Froude tank; the propeller problem researches carried out by Professor Osborne Reynolds, Sir John Thornycroft, Sir Charles Parsons and others; Sir John Biles' experiments on H.M.S. Wolf to determine certain facts relating to the strength of ships; Dr. Montgomerie's work on the stresses in ship structures; Professor Dalby's experiments on the balancing of marine engines, and his extensometer for the measurement of strain; Professor Inglis' work on stresses in steel plates, and that of many others constituted a record of which any Institution might well feel proud. It was very satisfactory to note that the younger scientists of to-day were following in the path trodden by their illustrious predecessors.

The two Post-Graduate Scholarships, one given by the Royal Commissioners of the 1851 Exhibition and the other founded in memory of the late Sir William White, both offered splendid opportunities for training the best products of technical universities in that field of applied science. Much remained to be done in the field of research for shipbuilding and marine engineering, and Great Britain did not compare favourably in regard to the money which was available for experimental research with other countries where very large sums were contributed by the Governments, private individuals and by great industrial corporations. In this country, although certain industries spent liberally on research and the Department of Scientific and Industrial Research had funds which were expended on seconding the efforts of private enterprise, yet the interest of the private firms must be mobilised before Government stepped in to help. In regard to shipbuilding the William Froude tank had done magnificent work in the fourteen years of its existence, but there was no use overlooking the fact that its future activities were seriously threatened for lack of financial support. The present industrial depression made it difficult to raise money. What might be done in the shipbuilding industry might be seen from what was actually now being done in the mining industry, where there existed a fund for research and education which by a levy of ¼d. per ton on coal raised in the United Kingdom provided some £100,000 annually for that purpose. A levy of ¼d. per ton on the output of the British shipyards for 1924 would produce £1500 per annum, which was the sum required from shipbuilders to maintain the research fund of the William Froude tank. He appealed, therefore, to all those who realised the value of this tank work, not only to contribute now to the William Froude Tank Research Fund, but to establish for the future a permanent scheme for raising annually the necessary funds by

a *pro rata* contribution from all the firms in the United Kingdom.

Sir John Biles presented a paper dealing with the relative efficiency of steam and Diesel engines for large passenger ships. An abridgment of this paper is given on page 369. Sir John Biles gave additional figures showing the total expenses of the three types of machinery for the cross-Channel services. The Diesel, he said, would cost about £28,600 a year to run, the turbine about £24,500, and the H.P. system about £22,000.

Mr. H. A. Ruck Keene, in opening the discussion, said that the author had given a most interesting and instructive paper on the comparison between steam engines and oil engines for high-speed passenger vessels. He agreed that the steam engine was not "dead" and that for some types of merchant vessels it would hold its own for many years. Since the war the oil engine had made very great progress and about 30 per cent. of the total tonnage of cargo and passenger vessels being built in British yards was being fitted with oil engines. In Germany the percentage was far higher. Of the thirty vessels of about 233,000 tons being built in that country for classification with Lloyd's Register, 94 per cent. of that tonnage was being fitted with oil engines. The development of the double-acting Diesel engine would naturally enable a far higher horse-power per shaft to be developed than in the case of single-acting engines, and Diesel engines of that type were now under construction developing 9000 brake horse-power per shaft. The figures given in Table III. of the paper regarding the annual cost of different types of steam and Diesel engines for a voyage of 120,000 miles were most interesting, as they showed that in the case of engines of 27,000 shaft horse-power and 13,500 shaft horse-power the annual cost of the proposed high-pressure steam turbine engines fitted with water-tube boilers of 500 lb. pressure and 700 deg. Fah. steam temperature was less than that of Diesel engines. The question of higher boiler pressures with water-tube boilers and superheat was being considered by several firms in this country and abroad. In Table I. the consumption of fuel in the case of the Aorangi as compared with that of a somewhat smaller vessel fitted with steam engines, with oil-fired boilers, but of approximately the same shaft horse-power, showed an immense reduction in favour of the Diesel engine. With the rapid increase of oil engines for marine purposes in all countries the question of the *personnel* became one of great importance, but the adaptability of the sea-going engineer would soon overcome that difficulty. In the case of shipowners who had already a fleet of motor ships there was no difficulty, but with other shipowners, whose engineering staff had only had experience with steam engines, the problem was more difficult, as, among other things, the timing and the adjustments of parts of Diesel engines was far finer than in the case of the steam engine.

Engineer-Captain William Onyon expressed the opinion that the paper did not make a sufficiently good case for the steam engine. Before deciding on the relative merits of steam and Diesel engines for ship propulsion the service on which the vessel was to be employed must be considered. Undoubtedly, the first quality in any passenger ship was reliability; everything was subordinate to that quality. In the case of an Atlantic liner which usually completed ten round voyages per annum, if one trip was lost by the vessel being laid up for repairs, the shipowner sacrificed from £20,000 to £30,000, which was far greater than any sum that could be saved in a year's working by adopting Diesel engines. In his opinion, to revert from a rotary motion to a reciprocating motion for high-speed ships was a retrograde step. Sir John Biles referred to the Aorangi as a high-speed Diesel vessel. He would call the speed of the Aorangi moderate and preferred to compare the performance of the Orama of the Orient Line and the Conte Verde of the Lloyd Sabaudo Line, the figures concerning which had been extracted from the engineering papers. Sir John Biles, in Table II. of page 4 of his paper, gave for the Diesel engine a figure of .5 lb. of fuel per shaft horse-power per hour, and for the steam plant he gave 1 lb. The shipowner was not concerned very much with the pounds per shaft horse-power, but with the distance run per ton of fuel. On the measured mile trials of the Aorangi the speed was 18.237 knots for 12,400 brake horse-power, and the fuel consumption for main and auxiliary Diesel engines was given as .431 lb. per brake horse-power. That vessel carried, however, two boilers and was fitted with refrigerating machinery, and it did not appear that these were in use during the trials. He had obtained information from the Fairfield Company that the Aorangi used 55 tons of fuel oil per twenty-four hours for all purposes on her recent voyage to New Zealand, maintaining a speed of 17 knots for the whole distance. For 17 knots the shaft horse-power required was 10,000 and the fuel consumption for all purposes was therefore .513 lb. per shaft horse-power. For an Atlantic voyage with the Aorangi brought up to 16,500 horse-power the figure would be .53. The horse-power of the Orama, Oronsay, and Conte Verde was about 16,500 at a speed of 19 knots. To bring the Aorangi to this figure it would be necessary to use 94½ tons of fuel per twenty-four hours. The fuel consumption for the Conte Verde was 155 tons, and if Diesel generators were substituted for turbo-generators and the auxiliaries were driven electrically the figure was reduced to 131 tons. If pre-heaters were fitted to the boilers a figure of 124 tons per day, which could be guaranteed, was obtained. The figure quoted for the Orama's trial was 136 tons, so that in her case with Diesel generators and pre-heaters the consumption would be less than 124 tons per day. The prices of oil fuel quoted by Sir John Biles were not quite correct. Diesel oil cost £1 per ton more than oil to be burned under boilers, and it was more economical to use the present steam plant than Diesel machinery for a ship of the "Orama" class. Most shipbuilders and marine engineers would be delighted to build and guarantee the performance of such engines as were indicated in the tables by H.P.T., but it was not necessary to go to the extreme pressures and temperatures mentioned in the paper to prove that the steam turbine would hold the field for many years to come in high-speed ships. Water-tube boilers for high-speed passenger ships were not very popular among the superintendent engineers in this country, in spite of the enormous saving in weight where fitted. It was a fact, of course, that the weight of turbine machinery per shaft horse-power tended to decrease with increase of power. One excellent reason for preferring steam to Diesel driven in high-speed ships was the possibility of reverting to coal burning in a steamship if oil fuel prices rose to a prohibitive degree. It had been claimed that coal dust could be burned in a Diesel engine, but he was not aware that anyone had made a commercial success of this. In conclusion, he would say that the turbine was very flexible; the Diesel engine was not, and that fact had no doubt been borne in mind by the owners of the Aorangi when fixing the size of the engines, which had a great margin. It was realised that it was inadvisable to sit on the safety valve of a Diesel engine. The extension of the powers of the Diesel engine might be made possible by the adoption of the Vulcan gear, in which several high-speed Diesel engines were connected by hydraulic clutches to one shaft, the reversing being done either by a separate hydraulic clutch or by reversing the engine itself.

Sir Charles Parsons welcomed the statement that the steam engine was far from being dead. The chief advantages of the Diesel engine were realised with small units. For land work it was believed that the turbo-electric generator would be more economical than the Diesel-electric unit. With regard to higher boiler pressures, the sea-going engineer did not welcome that development, but the employment of the pressures to which reference had been made should not present any real difficulty. An experimental plant which had been set up in the United States was working at 1250 lb. His own opinion was that at 500 lb. the greater part of the economy associated with high pressures could be attained; but he saw no reason why 1000 lb. should not become a practical possibility. Boiler makers asserted that it was as easy to maintain boilers at high as at moderate pressures if certain precautions were taken. It was necessary to prevent the possibility of salt entering the boiler and the split condenser had been employed to ensure safety in that connection. With that arrangement, if salt obtained entry into one condenser, it was possible to shut it off and to carry on with only a slight reduction of revolutions. Care had also to be taken with the steam pipes to prevent leakage and waste of steam and fuel. It was gratifying to learn that boilermakers were attacking with success the problem of high pressures, as the boiler was the crucial point of the installation. Looking at the question from a broad standpoint, his company would be prepared to guarantee results from marine steam turbines equal to the Diesel engine in running costs and other firms could do the same.

Mr. Harold Yarrow intimated that manufacturers saw no difficulty in building boilers for working pressures of 500 lb. His firm had made boilers for 400 lb. pressure with a capacity of 100,000 lb. of steam per hour, and boilers could be made to withstand even higher pressures if solid drums were employed. Drums of the type required could be supplied by British steel works. On the subject of the efficiency of the water-tube boiler he could give figures for two boilers very similar to the Yarrow 500 lb. boiler illustrated in the paper. Those boilers had an evaporative capacity of 9 lb. to 10 lb. per square foot of heating surface. One was oil fired and the other coal fired by chain-grate stokers. The efficiency figure came out at 85 per cent., and he would have no hesitation in supplying boilers of that efficiency for marine work. The pressure would be 500 lb. and a steam temperature of 700 deg. Fah. would be employed.

Mr. W. J. Belsey said that in the presidential address of Mr. Patchell to the Institution of Mechanical Engineers a list of thermal efficiencies of various generating stations throughout the world was given, and amongst those which stood very high was the Ratcliffe power station of the Lancashire Electric Power Company. A test taken on that station showed that with moderate steam conditions, 160 lb. at the boiler and 150 lb. at the turbine, and with a total temperature of 524 deg. Fah. at the boiler and 512 deg. temperature at the turbine, a kilowatt-hour was delivered at the switchboard for an expenditure of 19,251 B.Th.U., including all auxiliaries. That, with oil fuel at 18,500 B.Th.U., was equivalent to .8 lb. of oil per horse-power hour. There were rather more auxiliaries in use on a ship than in a generating station on land; but making allowance for that, no ship at sea could compare in economy with that and other generating stations on shore. At the same time, there was considerable room for improvement in marine steam plant, even with existing pressures, and if pressures and temperatures were increased up to from 350 lb. to 500 lb. absolute, with from 200 deg. to 300 deg. superheat, there was no reason why a lower figure even than that given by the author of the paper should not be obtained in practice. A considerable number of the existing objections to the use of high-pressure steam at sea would be eliminated if electric transmission were adopted for propelling purposes. With an electric drive all danger of trouble with the reverse turbine would be eliminated, the arrangement of the machinery and steam piping would be extremely simple, and if any trouble due to a leaky condenser arose, it would be a simple matter to shut down that plant, carry out a few simple switch operations, and proceed at half power until the leaky tube had been repaired. For a turbine electric propelling equipment of 27,000 shaft horse-power, operating with a steam pressure of 475 lb. absolute, superheated to a total temperature of 700 deg. Fah. and exhausting into a vacuum of 29in., with a barometer of 30, a steam consumption could be guaranteed under very heavy penalties of 6.85 lb. of steam per shaft horse-power per hour, including all losses in the electrical transmission. Given a boiler efficiency of 80 per cent. and bleeding the turbine for feed heating and an auxiliary load of 1250 kilowatts on the auxiliary turbines, a fuel consumption of .63 lb. of oil could be obtained, with oil at 18,500 B.Th.U. per pound.

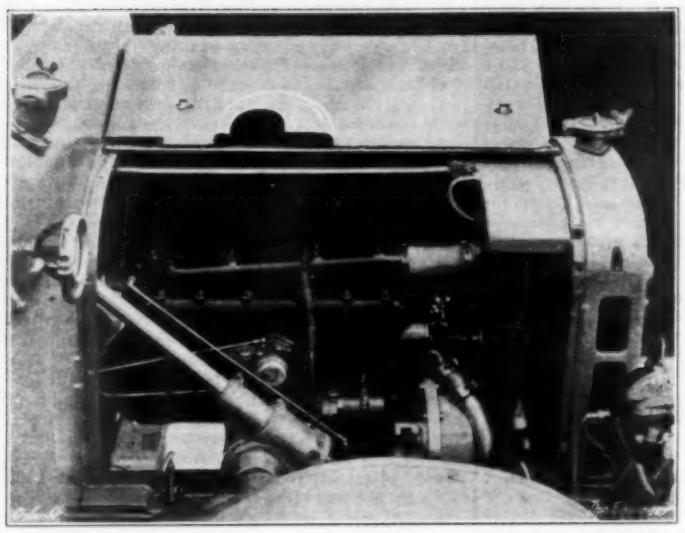
Mr. R. J. Walker said there were several geared turbine vessels in service where the oil fuel consumption for all purposes was in the region of .8 lb. per shaft horse-power with boiler pressures of from 200 lb. to 215 lb. and superheat from 100 deg. to 200 deg. Fah. In reference to the high efficiency scheme referred to, it was estimated that a figure at least 5 per cent. lower than the figure of 7 lb. given in Sir John Biles' estimate could be obtained. The steam consumption in the particular proposal referred to in Column C of Table II. for 27,000 horse-power was estimated at 6.9 lb. per shaft horse-power, and allowing what might be considered a fair consumption for the auxiliaries—1.65 lb.—that equalled a total steam consumption of 8.65 lb., corresponding to an oil consumption of .66 lb. per shaft horse-power at a boiler efficiency of 84 per cent., with steam pressure of 500 lb., total temperature 700 deg. Fah., and 29in. vacuum, the auxiliary exhaust being utilised to heat the feed to 200 deg. temperature. The important part which auxiliaries played in the economical working of the geared turbine installation was generally appreciated by marine engineers, and whilst economy in steam consumption had been increasingly effected in marine turbines, the same, however, could hardly be claimed for the auxiliary engines. In the high efficiency proposal alternative schemes of auxiliaries had been suggested, including an arrangement of independent steam auxiliaries, electrically driven auxiliaries by a turbo-generator of high efficiency, or electrically driven with a high-speed Diesel driving the generator. The alternative of driving the generator from the main shaft would give a very economic arrangement. In the case of all steam-driven auxiliaries the exhaust could be utilised for heating the feed water, but in the case of the electrically driven auxiliaries it would be necessary to withdraw the steam from the main turbines for heating the feed. The ideal condition for steam auxiliaries was undoubtedly that in which the consumption of auxiliary power was reduced to such an amount that all the exhaust could be utilised for feed heating. The general trend of development at the present time in land steam plant was in the direction of higher pressures and temperatures, and their application to marine work did not appear to present any insuperable difficulties. The arrangements of piping, jointing and insulation required, of course, to be designed to meet marine conditions. A considerable advance had been made in regard to the improved efficiency of boilers, and with pre-heating of the air efficiencies from 84 to 90 per cent. were now being promised by boiler manufacturers. Whilst Sir John in his paper had confined the comparison made to passenger vessels, the same high efficiency scheme could be obtained in cargo vessels. In the case of the Cairnrow, belonging to the Cairn Line, the vessel was fitted with geared turbines of 2700 shaft horse-power working on a single screw, the boiler pressure being 200 lb. and superheat 200 deg. Fah. The coal consumption on active performance was about 1.15 lb. per shaft horse-power. With boilers of 500 lb. pressure the figure could be reduced to 1.0 lb. per shaft horse-power. Even taking the Cairnrow with her present machinery, it was difficult to see what advantage the oil-engined ship would have over the "Cairnrow" type with coal at under 20s. per ton and oil fuel purchased in the open market at round about 90s., to say nothing of the interest and depreciation as a first charge on the considerable addition to the practical cost of the Diesel ship.

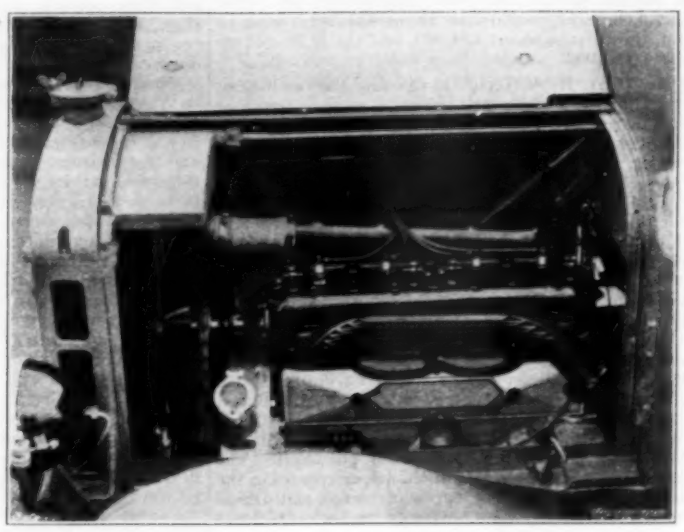
Professor Welch referred to the paper read by Professor Mellanby and Mr. Kerr before the North-East Coast Institution on the efficiency of steam plant at high pressures and temperatures. It was shown

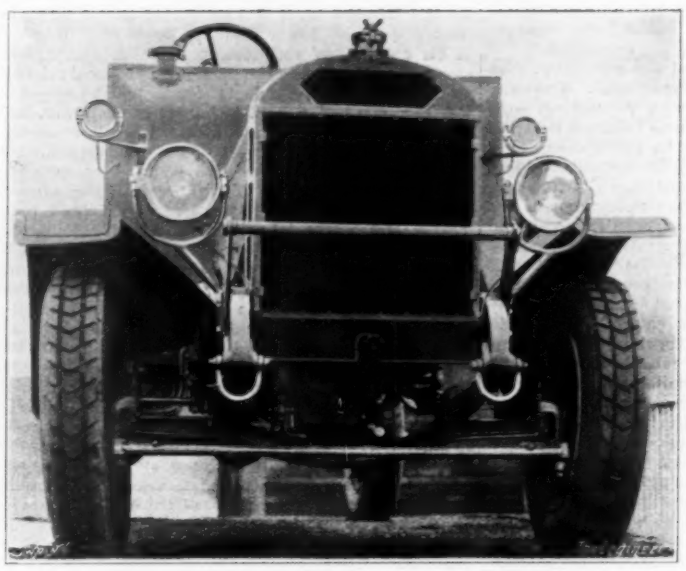
A WAR-OFFICE SUBSIDY 2-TON CHASSIS

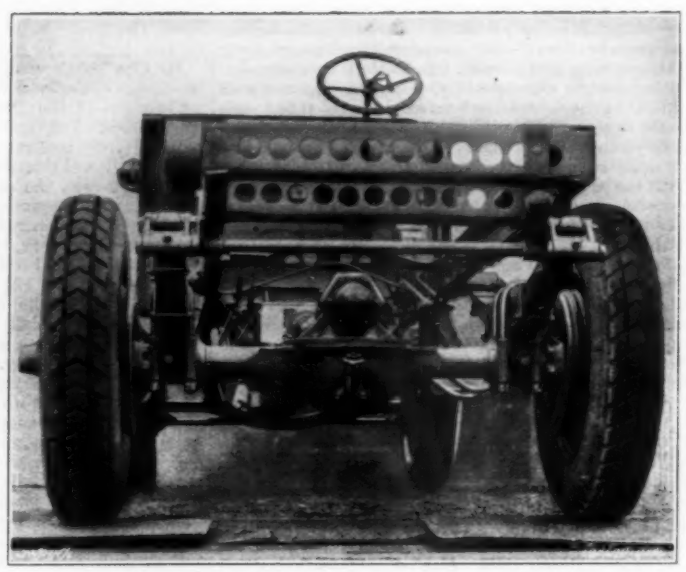
THE VULCAN MOTOR AND ENGINEERING COMPANY (1906), LIMITED, SOUTHPORT, ENGINEERS

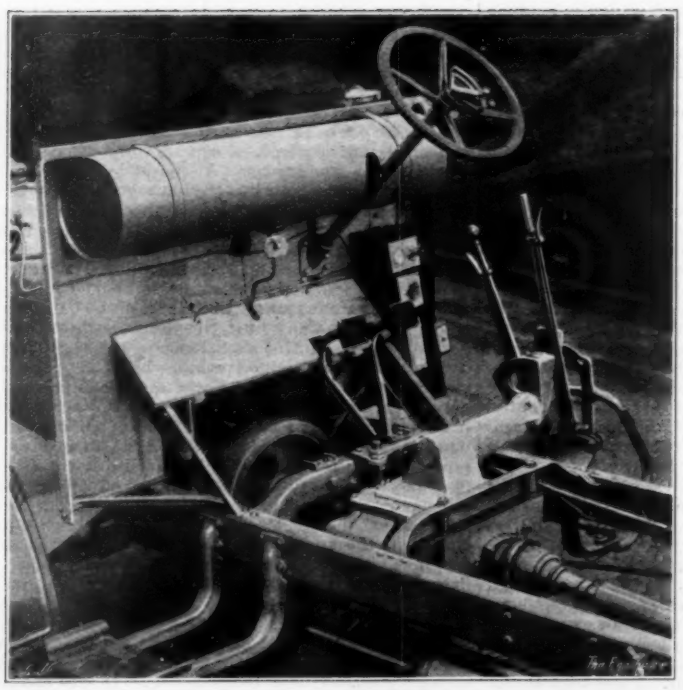
(For description see opposite page)

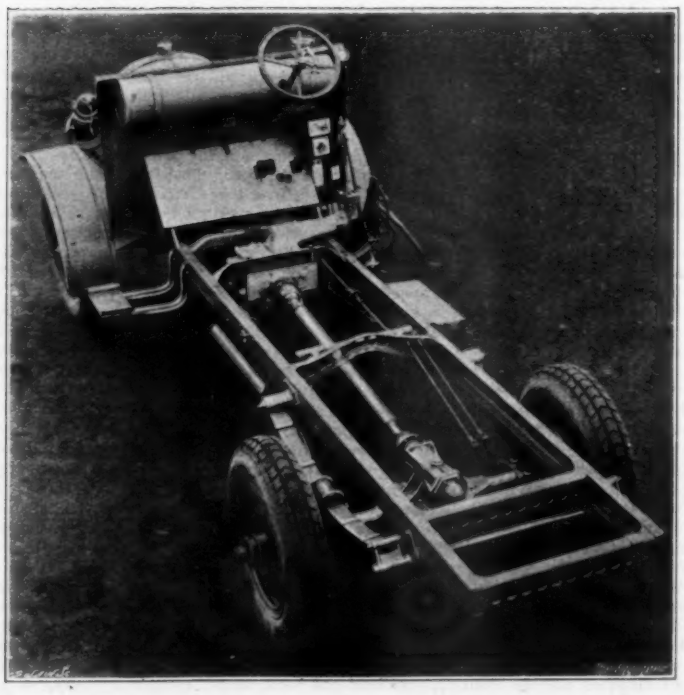












in that contribution that at about 900 lb. pressure and at temperatures up to 1000 deg. Fah., or a little higher, the efficiency of the plant would be raised to a point where the consumption of oil would be only .37 lb. per shaft horse-power hour. It was admitted that such pressures and temperatures were not likely to be reached in marine work, but he was confident that there was a large field open to the marine steam engineer.

Sir James Kemnal said that his company had supplied several installations which were working at 500 lb. pressure, and experience indicated that the risk of trouble with the condensers had been exaggerated. The moment any shipowner had the courage to order the plant his company would be pleased to fit any ship with boilers to work at 500 lb. and to guarantee satisfactory operation. His firm had made experiments at pressures up to 800 lb., using the steam exhaust in exhaust turbines.

Sir Westcott Abell reminded the meeting that many shipowners believed in the Diesel engine ship, and it could be claimed that for the bulk of the maritime traffic of the world the Diesel engine was a suitable propelling unit. On the subject of efficiency there were two measures of that quality: the economic efficiency, which appealed to the shipowner, and the technical efficiency, and sometimes the search for the latter was pursued far beyond the limits of economic efficiency.

Professor Percy Hillhouse gave some additional details regarding the performance of the Aorangi. The fuel consumption was for all purposes .46 lb. per shaft horse-power hour, and for the main engines .392 lb. It had been found that the gain in deck area was mainly on the lower deck. With regard to the increase in carrying capacity of the motor ship as compared with the steamship, it could be looked at from two standpoints. It could be utilised to decrease the size of the ship for the same weight of cargo or a larger quantity of cargo could be carried in a vessel of the same size.

Mr. J. H. Narbeth said that when Sir Fortescue Flannery read his paper a letter was read from Lord Fisher to Lord Bearsted, written a good many years ago, in which regret was expressed by Lord Fisher that during his tenure of office at the Admiralty he had not had a Diesel battleship built. It would, of course, have been impossible to fit a battleship with internal combustion engines for purposes of propulsion at that time. It was not generally known how much experimental work on the Diesel engine had been done by the Engineering Department of the Admiralty, and that Department was fully alive to the need of carrying on that work. In face of the reliance of the Navy on oil fuel it was necessary to concentrate on the development of a practical scheme for the production of oil from coal. The difficulties in working out a commercial process had been accentuated by the fall in the prices of the by-products, on which the financial success of the process might depend. He suggested that a research plant should be established at Haslar to investigate the synthetic treatment of coal.

Sir John Biles, in winding up the discussion, commented on the absence of any challenge to his argument from the advocates of the Diesel engine ship. Perhaps there was a fashion in engines, as in other things, and he was not at all sure that some shipowners had not fallen victims to the fashion. Reference had been made to the question of reliability, and all were agreed that that quality was demanded in marine propelling machinery. The reliability of the Diesel engine was not yet quite unquestioned. With regard to the advantages of split condensers, that method had been tried on Atlantic liners. He had made inquiries of the superintendent engineer of a company having in service large ships fitted with water-tube boilers, and he had been informed that no trouble had been experienced with the condensers. Boilermakers had now given an assurance that boilers to work at 500 lb. could be built to work satisfactorily. His paper was written to deal with the economic side of the question, and he had left the technical aspects of the controversy alone. Sir Fortescue Flannery and Lord Bearsted, who had championed the Diesel engine at a recent meeting of the Royal Society of Arts, had been invited to be present to give expression to their opinions and he regretted that neither of them was present.

The annual dinner of the Institution took place at the Connaught Rooms on Wednesday evening, and there was a large attendance. The chair was taken by the president, the Duke of Northumberland, who, after the loyal toasts had been duly honoured, proposed the toast of "The Naval and Air Forces of the Empire." This toast was acknowledged by the Right Hon. W. C. Bridgeman, the First Lord of the Admiralty, and by the Air Chief Marshal Sir Hugh Trenchard. His Excellency the Japanese Ambassador, Baron Hayashi, proposed the toast of "The Mercantile Marine," and Mr. John Denholm, president of the Chamber of Shipping of the United Kingdom, replied. "The Institution of Naval Architects" was proposed by the Right Hon. Sir Joseph Cook, the High Commissioner for the Commonwealth of Australia. The President acknowledged the toasts in suitable terms.

A War Office Subsidy 2-Ton Chassis.

THE 2-ton motor chassis illustrated herewith and on page 378 has been designed and constructed by the Vulcan Motor and Engineering Company (1906), Ltd., of Southport, to meet the requirements of the British War Office's No. 11 Specification. It has passed the necessary tests and has been declared by the War Office to be eligible for enrolment under the subsidy scheme, under which the owners receive a sum of £120 over a period of three years. The makers understand that they are the first manufacturers to obtain the approval of the War Office for a vehicle constructed in accordance with the Department's latest No. 11 Specification.

The four-cylinder engine is of the cast iron monobloc type with cylinders of 95 mm. bore and 140 mm. stroke, equivalent to a cubic capacity of 3965 c.c. At 1000 revolutions the engine develops 28.8 brake horse-power and at 1400 revolutions 39 brake horse-power. The cylinder head is detachable and is provided with four lugs at the corners for facilitating its removal. Primary cocks are arranged on the head and an aluminium top water pipe is bolted to it. The cylinder block and the crank case, of aluminium, are united by the main bearing bolts, which are extended through the case. The unit as a whole is supported at three points in such a way as to ensure its freedom from the effects of frame distortion. On the near side of the crank case a flange is provided for the attachment of a dynamo.

The valves, of 3 per cent. nickel steel, have a throat diameter of 2in. and are operated by means of silent roller tappets which work, in the presence of an oil mist from the crank case, in a closed chamber provided with a removable cover. The cam shaft is supported in three bearings lubricated by pressure feed. Aluminium alloy is used for the pistons and the gudgeon pins are so arranged that should they work loose they cannot, it is claimed, score the cylinder wells. Both the connecting-rods and the crank shaft are stampings of 40-ton steel. The rods are fitted with bronze bushes at the small ends and the crank shaft with a double end thrust washer. The crank pins are chambered to provide a pressure feed to the connecting-rod big ends. The connecting-rod and main bearings are of bronze backed with white metal liners and can be inspected by removing the bottom half of the crank case without taking the engine off the chassis.

A silent chain of the Renold's type arranged in the form of a triangle drives the cam shaft and magneto from a pinion on the crank shaft. Any wear or stretch of the chain may be adjusted externally under running conditions by means of a jockey pulley mounted on ball bearings. Care has been taken to ensure that the jockey pulley is fixed in such a way that the chain drive is not disturbed when the timing cover is removed. On the timing cover on the near side a combined filler and breather is arranged, and in addition a breather is provided on the top half of the crank case.

The fly-wheel is of cast iron, and on its rim various settings are marked in order that the timing may be readily set from a fixed pointer on the cylinder block. The carburetter is of the Zenith horizontal pattern and a Simms high-tension magneto, which is connected to a driving spindle by a Simms coupling, is mounted on a platform on the off side of the crank case.

The lubrication of the engine is derived from a gear type pump submerged in the sump and driven by skew gearing from the cam shaft. Oil is forced through a pressure filter to the main bearings and through steel pipes and holes drilled in the crank shaft and crank case to the big ends of the connecting-rods, the cam shaft bearings and the chain drive. A suction filter is arranged in the sump in such a way that it may be withdrawn for cleaning purposes without any loss of the main body of oil in the crank chamber. An oil level indicator of the Dipstick type on the near side of the crank case indicates high and low levels of the oil, for which a capacity of 2 gallons is provided. In the bottom of the sump a large draining plug is fitted.

A water pump and fan, the latter with blades shaped to a true helix, are mounted as a combined unit at the front of the cylinder block.

The clutch is of the direct cone type with a Ferodo lining and is fitted with adjustable springs and a clutch stop. It is connected to the gear-box by means of a flexible fabric joint which is designed to permit the clutch to be withdrawn without the dismantling of the engine or gear-box. The gear-box, of aluminium and suspended at three points to nullify the effects of frame distortion, provides four forward and one reverse speed. With the engine running at 1000 revolutions the gear ratios and road speeds are as follows:—

Gear.	Ratio.	Speed, m.p.h.
Top	7 to 1	14½
Third	11.9 to 1	8½
Second	18.34 to 1	5½
First	31.22 to 1	3½
Reverse	40 to 1	2½

The gear wheels are of the stub tooth type and are mounted on shafts running in ball bearings. The gear wheels are controlled by means of a right-hand gate change of H shape, a safety catch for the reverse gear being provided on the change speed lever. The side arm is arranged to clear the adjacent frame member so that it may not be affected by any frame distortion. A positive lock on the selector forks prevents more than one gear being engaged simultaneously. The gear case is equipped with a breather and an oil level cock.

The transmission from the gear-box to the rear axle is effected by a tubular shaft provided with internal ring universal joints of the Spicer type. These joints are completely enclosed in cases which are partly filled with soft grease. The rear axle is of the full floating pattern and consists of a one-piece pot-shaped steel stamping. The overhead worm and wheel reduction gearing has a ratio of 7 to 1, and with the bevel differential gear is carried in a separate housing that can be readily removed without disturbing the axle casing. Ball bearings and a large ball double thrust washer are provided for the worm shaft. The drive is conveyed to the road wheels through shafts of 100-ton steel. The hubs of the road wheels run on roller bearings of large diameter. Similar bearings for the front wheel hubs are provided. The front axle is an I section stamping of 40-ton steel. Steering is effected through a case-hardened worm and a bronze wheel mounted in a box on the frame member. The worm shaft runs on ball bearings and the worm is fitted with two single ball thrust washers.

The radiator is composed of vertical gilled tubes of $^{5}/_{16}$in. bore fitted to detachable top and bottom water tanks of aluminium. A total capacity of 8 gallons is provided. Arrangements are made for fitting a three-ply board to the radiator to regulate the cooling effect according to the weather, and a guard is fitted across the front to prevent damage to the radiator tubes.

The throttle and ignition controls operate in the usual way on a fixed sector on the steering column and are moved forward to speed up the engine. The foot control for the throttle works in conjunction with the hand control, the pedal returning to the position corresponding with the position of the hand control when the foot is lifted. Both the hand and the foot brakes operate on drums of large diameter on the rear axle. They are of the internal expanding type with easily renewed shoes lined with Ferodo.

The frame is made of 3 per cent. nickel steel with side members 5in. deep and at the rear end is designed to take the War Office pattern of spring towing draw-bar. A petrol tank of 13 gallons capacity is mounted on the rear of the dashboard. The feed is by gravity. A two-way cock is fitted which, when in the normal position, retains 2½ gallons in the tank and which when in the third position releases this reserve. The filler cap is of the same pattern as the radiator cap and is fitted with a removable gauze strainer. Between the tank and the carburetter a filter is fixed in an accessible position. The petrol piping is situated on the off side of the engine so as to remove it away from the hot exhaust piping on the near side. The steel disc wheels are made to the War Office specification and are fastened to the hubs by War Office standard studs and nuts. The tires are of solid rubber and measure 100 mm. by 720 mm.

The chassis has an overall length of 17ft. 2½in., an overall width of 9ft. 2in., and a wheel base of 11ft. 5in. The wheel track at front is 4ft. 10in. and at rear 4ft. 8in. The chassis has a turning circle diameter of 45ft. to the right hand and 44ft. to the left hand. Its total weight is 3½ cwt. and its weight laden 85 cwt. The fuel consumption is given at 13 miles per gallon.

VULCAN WAR OFFICE SUBSIDY 2-TON CHASSIS.

AT a district meeting of the Institute of Cleansing Superintendents held at Leicester recently, Mr. E. Hobson, cleansing superintendent of Leicester, gave an address on the work done in the city, and paid special attention to the question of mud-splashing due to vehicular traffic. He said that there were two remedies—one to have the paving of a smooth uniform surface, so that the water would run off and not lie in pools, and the other to slow down all motor traffic to a walking pace when passing through busy streets.

The Conversion of the s.s. Bintang.

In a paper read by Mr. L. J. Le Mesurier before the North-East Coast Institution of Engineers and Shipbuilders on Friday last, some interesting figures were given concerning the conversion of the steamship Bintang to a motor vessel by installing in it a Sulzer type marine oil engine. The Bintang is owned by the Nederland Steamship Company and was built in 1916. She has a length of 417ft. 8in., a breadth of 54ft. 6in., and a depth of 38ft. 6in., with a deadweight carrying capacity of 9700 tons and a displacement of 14,000 tons. Her original propelling machinery comprised a single set of 3600 indicated horse-power triple-expansion steam engines designed to give her a speed of 12 knots. Steam was raised in four single-ended boilers arranged to burn either oil or coal. Her new machinery consists of a six-cylinder two-stroke Sulzer engine with a direct-driven scavenge air pump. The engine cylinders are 30in. in diameter with a stroke of 53in., and are rated at a normal output of 3600 brake horse-power when running at the low speed of 90 revolutions per minute. The auxiliary machinery includes two 50-kilowatt Diesel-electric generators and a 160 brake horse-power oil engine directly coupled to an air compressor. Steam-driven deck auxiliaries and steam heating are retained, two small boilers being employed for this purpose. The main auxiliaries, including the steering gear, are all electrically driven. Contrary to usual practice, the engine is arranged with its controls at bottom platform level, and the scavenge pumps and air compressors are driven direct from the engine crank shaft. It may be observed that the main propelling engine is the largest marine oil engine so far constructed for a single-screw ship. During the shop trials of the engine an overload output of 4390 brake horse-power was developed at 96 revolutions per minute, while the fuel consumption at the normal load was shown to be 0.410 lb. per brake horse-power hour and at three-quarters load 0.390 lb.

Making a comparison between the fuel consumption of the vessel before and after conversion, it may be noted that the original steam machinery used 58 tons of coal per day at sea or 41 tons of oil, while in harbour 7 tons of coal or 5 tons of oil were used. With the new oil engine, which develops the same power, a total of 14.7 tons of fuel oil per day for all purposes is required at sea, and the average consumption in port is estimated at not more than 3 tons. Taking the trade route of the vessel, Holland-New York and the Dutch East Indies, about 280 days will be spent at sea and 85 days in harbour per year. With coal at 33s. per ton and Diesel oil at 65s. per ton, the annual fuel cost before and after conversion, comparing coal and Diesel oil, works out at £27,780 and £14,230, showing a total annual saving in respect of the motor ship of £13,550. Moreover, the total radius of action of the ship, which was only 43 days before conversion, is now increased to 164 days. For the steam machinery four engines and twenty firemen, trimmers and greasers were required, while with the oil engine only one chief engineer, four engineers, two junior engineers, and eight greasers will be required, giving an estimated saving of wages and subsistence of £1440 per annum. With regard to lubricating oil, the consumption at sea will be increased from 8 to 24 gallons, which, at 3s. per gallon, will increase the consumption of the converted ship under this heading by about £1000; against this, however, may be set off the cost of the supply of feed water in the steamship, which may be reckoned at £500. The actual cost of the conversion is not anticipated to exceed £70,000, and the estimated saving on the fuel bill and staff expenses amount to approximately £15,000, from which £500 for extra lubricating oil must be deducted. This leaves a net annual saving of about £14,500 per annum, or a return of over 20 per cent. on the capital invested, which should cover all charges and leave a margin for profit. This estimate does not take into account the extra cargo-carrying capacity of the ship, which has been increased by about 10 per cent. by conversion.

Studies of Atomic Nuclei.

In his discourse at the Royal Institution on Friday, March 27th, on "Studies of Atomic Nuclei," Sir Ernest Rutherford stated that the atoms of the elements were now known to have the same general type of structure, consisting of a minute charged nucleus surrounded at a distance by a number of electrons in motion. It was, he said, of great importance to determine the nature and magnitude of the forces that held the atom in equilibrium, and to form some idea of the size of the nucleus and of its constitution. The most direct method for that purpose was to examine the scattering of swift charged atoms like α particles, when they traversed matter. The α particles were so energetic that they passed through the structure of the atoms in their path, and occasionally one passed close to the nucleus where the electric field was so intense that it was deflected through a large angle. By examining the numbers of particles scattered through different angles and the variation of the number with the velocity of the α particle, we could test whether the law of force between the charged nucleus and the charged α particle followed the ordinary laws of the inverse square. It had been known for some time that that law appeared to hold over the greater part of the space occupied by the atomic structure. It broke down, however, when the particle approached very close to a light nucleus like that of hydrogen or aluminium.

An account was given of a detailed study of the law of force by noting the variation of the number of α particles of different initial velocity scattered nearly backwards from the bombarded material. In this way it was found that there is a sudden change in the law of scattering for aluminium for a definite velocity. Experiments made with thin films of gold and uranium showed that the law of the inverse squares held to the closest distance of approach of the α particle to the nucleus, viz., about 3×10^{-12} cm. This, remarked Sir Ernest, was a very remarkable fact, for, from radio-active information, it was believed that the nuclear structure of uranium extended to more than twice that distance. A discussion was given of the various hypotheses to account for the observed facts, and it was pointed out that a distribution of charged electric doublets in the form of satellites extending some distance from the central nucleus might account for the effects observed both in aluminium and uranium. It was pointed out, too, that a large amount of careful work on a number of elements was necessary before a definite decision between various hypotheses could be reached.

An account was also given of the liberation of protons from a number of light nuclei when bombarded by very swift α particles, showing that a change in nuclear structure could be brought about by intense collisions between α particles and nuclei. The fate of the α particle after liberating a proton had always been a matter of great uncertainty, but some recent experiments by Blackett, in which he had photographed by the cloud method the tracks of nearly half a million α particles, had shown that in the case of nitrogen, the α particle appeared to be captured by the nucleus. Eight photographs were obtained of a disintegrating collision in which the track of the expelled proton and the recoiling nucleus were clearly seen, but no trace of a third particle. These results indicated that in the case of nitrogen there was on the whole a building-up rather than a disintegration of a nucleus of mass 4. This result was, added Sir Ernest, of great importance and interest, but we were still far from understanding the mechanism of such disintegrating collisions.

JUNIOR INSTITUTION OF ENGINEERS.

On Friday, March 27th, Mr. A. P. Morris gave a talk before the Junior Institution of Engineers on the subject of "Irrigation Engineering in Burma." He said that most of the land in Burma was state-owned, and that the works necessary for the irrigation of rice fields were paid for by water rate levied on the cultivators. The present rate was about 4s. per acre, and the amount collected did not permit any elaborate machinery to be used. The water was conducted to the fields by means of canals from the rivers which rose in the mountain districts, where the rainfall was as much as 200in. a year. The canals were filled by damming the rivers, and the dams were made either of masonry or earth, or a combination of the two, with stout walls made of pickets driven into the ground. In the construction of all these works, Mr. Morris said, the question of labour was one of the least importance, for it was cheap and plentiful, and as long as local materials were used the expenditure was kept within the limits allowed. More modern methods, such as the use of reinforced concrete, were not feasible, first owing to the cost of the materials, and secondly on account of the supervision it was necessary to provide over the native labour. Wages were, however, now nearly double what they were before the war.

Mr. Morris mentioned that machinery sent out from home to out-of-the-way parts of the Empire was often not given a chance to show its usefulness, because the selling agent knew nothing about the erection and operation of the plant. He suggested that a selling agent should have engineering as well as commercial experience.

EXHIBITION OF TURNERY.

An Exhibition of Turnery is to be held, by permission of the Lord Mayor, at the Mansion House this month. It is being organised by the Worshipful Company of Turners, and it will be open to the public, by ticket, on Wednesday and Thursday, 22nd and 23rd inst., from 11 a.m. to 4 p.m., and on the Friday from 11 a.m. to 2 p.m.

There are many people who do not know of the existence of the Worshipful Company of Turners, and many more who have never heard of its Exhibitions, though, as a matter of fact, the Company is one of the oldest of the celebrated City Guilds, and it was incorporated by Charter of James II., as its title implies, to "encourage the Art and Misterie of Turning." This charge it fulfils to the best of its ability by holding year by year open competitions in turned work, as well as in other ways. This year's competition is the thirty-eighth, and for the first time the amateur worker in metal has been included. It is considered that, with the increasing popularity of electrical apparatus, the amateur worker should now have a wider scope than ever for the application of his skill and ability, and it is hoped that a large number of entries will be received in this class. The professional turners, and the youths who will be the turners of to-morrow, have not been forgotten, and a number of awards await the successful competitors.

For convenience, the competition has been divided into three sections, dealing with (1) wood and other material not metal, (2) metals, and (3) previous first-prize winners, who are further subdivided into ten different classes, although it has been found impossible to include this year the pottery and glass classes.

A schedule, giving all details and copies will be sent to any who apply to Major John G. H. Budd, Assoc. M. Inst. C.E., the hon. secretary to the Competition Committee, 53, Haymarket, London, S.W. 1. The Lord Mayor has consented to distribute the prizes on Friday, April 24th, at 3 p.m., in the Egyptian Hall, at the Mansion House, and any who would like to visit the Exhibition or to attend the prize-giving, admission to which is free, can obtain tickets on application to Major Budd.

SIXTY YEARS AGO.

A great strike and lock-out in the iron trade of this country was coming to a close in March, 1865. The dependence of the engineering industry on puddled iron was then almost complete, but signs were not wanting that in the near future some measure of freedom would be afforded by the development and recognition of the qualities of the material known as "Bessemer metal." In our issue of the 31st of the month and year stated above we dealt with the subject in a leading article. After commenting upon the indifferent success achieved with various schemes for puddling iron by mechanical means, we emphasised the similarity between the action taking place in a puddling furnace and that occurring in a Bessemer converter. Doubt was still felt as to whether Bessemer metal was iron or steel, but we suggested that it should really be regarded as being both in one. We prophesied that many hundreds of thousands of tons of the metal would be produced annually before many years had passed. In substantiation of that belief we gave some particulars of the results secured with Bessemer metal on railways. On the London and North-Western Railway, we stated, a Bessemer rail and an iron rail were laid at a part of the line near Camden Town in 1861. After two years and four months, in which time it was estimated that some seven million trucks had passed over the section, the Bessemer rail was found to be in good condition and had not been turned. On the other hand, the iron rail had been replaced six times, each rail after being in service for some time having been turned. The steel rail thus had outworn both faces of seven iron rails. Again, at Crewe Station iron rails were being worn out in four months, each side giving two months' service. In November, 1861, the station was laid throughout with Bessemer rails, and at the date of writing these rails were still in service. They had not even been turned, and appeared to be good on the original face for another two years. Railway tires of Bessemer metal, we recorded, had been used, but they had failed in considerable numbers. The failure, however, was due to the fact that the tires had been made by a welding process. We argued that had they been formed from a solid block pierced and rolled to shape without a weld they would have been found satisfactory. Krupp tires were then being made in the manner indicated, and arrangements were being completed for making Bessemer tires in a similar way. We also referred to the use of Bessemer metal for the plates of a number of blockade runners built at Liverpool. The increasing number of firms engaged in the production of Bessemer metal would, it was held, soon cause it to fall in price, and thereby rapidly extend its use.

INSTITUTION OF ELECTRICAL ENGINEERS.

It is announced that at the invitation of the Committee of the South Midland Centre of the Institution of Electrical Engineers, a Summer Meeting of the Institution will be held in that centre from June 9th to 12th, next.

The programme will be as follows:—On Tuesday, June 9th, a visit will paid in the morning to the Prince's power station, Nechells, of the city of Birmingham electric supply department. In the afternoon a visit will be paid to the Witton works of the General Electric Company, Ld., where the party will be entertained to luncheon and tea as the guests of the company. In the evening there will be a civic reception and dance at the Council House by the Lord Mayor of Birmingham, Alderman P. Bower. On the Wednesday morning visits will be paid to the Longbridge works of the Austin Motor Company, Ld., and to the rectifier sub-station of the city of Birmingham electric supply department at Longbridge. Members will be entertained to luncheon at Droitwich as the guests of the Shropshire, Worcestershire and Staffordshire Electric Power Company, and afterwards they will proceed by steamer up the river Severn to Stourport to inspect the power station. Tea will be provided by the company. In the evening there will be a reception and dance at the University, Bournbrook, Birmingham, as the guests of the Principal of the University of Birmingham, Mr. C. Grant Robertson. On the Thursday the party will visit the works of the British Thomson-Houston Company, Ld., Rugby, and be entertained to luncheon as the guests of the company, and in the afternoon it will proceed to Warwick, where there is to be a civic reception by the Mayor of Warwick. Tea will be taken on the lawn of Warwick Castle as the guests of the Leicestershire and Warwickshire Electric Power Company, Hinckley; the Midland Electric Light and Power Company, Ld., Leamington; and the Leamington and Warwick Electrical Company, Ld., Leamington. In the evening there will be a gala night at Witton as the guests of the General Electric Company, Ld. The morning of Friday, June 12th, will be devoted to a visit to Stratford-on-Avon and Broadway, and the party will be entertained to luncheon at Evesham as the guests of the city of Birmingham electric supply department, and there will be a civic reception by the Mayor of Evesham. The afternoon will be spent at Evesham, where tea will be provided by the city of Birmingham electric supply department. In the evening there is to be a gala night at the Botanical Gardens, Edgbaston.

STANDARD STEELS FOR LAMINATED SPRINGS

The schedule of steels for laminated springs for automobiles—No. 5010, 1925—which has just been issued by the British Engineering Standards Association gives the chemical composition of six classes of laminated spring steel used in automobile work, with a list of the standard sections and the permissible margins of manufacture on the widths and thicknesses.

No definite heat treatment can be specified at the present time because of the variations in existing practice and the diversity of opinion, both amongst spring makers and users, as to the most desirable properties of a spring plate. The whole matter is at present under investigation by the Springs Research Committee set up by the Engineering Co-ordinating Research Board of the Department of Scientific and Industrial Research. Pending the issue of its report, it is recommended that a range of Brinell hardness to which every plate of an order should conform, be agreed upon between the spring maker and the purchaser, and in view of the difference of opinion as to the best range to be adopted, two alternative ranges have been put forward.

The specification includes a list of the automobile standards now available. Copies of the specification—No. 5010, 1925—may be obtained from the British Engineering Standards Association, publication department, 28, Victoria-street, S.W. 1, price 1s. 2d., post free.

Railway Matters.

THE electrical services on the Brighton section of the Southern Railway were extended to Coulsdon and to Sutton, *viâ* Wallington, on Wednesday, April 1st.

TWO railway engineers serve on the Works Sub-committee of six that is dealing with the safety of St. Paul's. One is Sir Charles Morgan, the late chief engineer of the London, Brighton and South Coast, and the other is Mr. E. F. C. Trench, the engineer-in-chief of the London, Midland and Scottish.

AN express train from Bordeaux to Paris, by the Paris–Orleans, was derailed near Poitiers on Wednesday, March 25th. Some of the carriages ran down an embankment into the river and five passengers were killed. One report said that the accident was caused by a broken rail; another that the road was under repair; whilst a third suggests that a rail was wilfully displaced.

SPEAKING recently, Mr. Marchbanks, the ex-president of the National Union of Railwaymen, said that the introduction of electric trains would soon render the engine-driver and fireman non-existent. The booking clerks would be substituted by slot machines for tickets, and old craftsmen at the bench by new machinery, and the result would be less work for the men. It was not for the benefit of the men that these improvements were taking place, but for the benefit of shareholders. The only comment that appears necessary for us to make is that it is to be regretted that the ex-president of so important a union should consider that such weak arguments can carry any weight.

THE Chicago, Milwaukee and St. Paul Railway, which has to meet bonds to the value of 48 million dollars, which mature on June 1st, has passed into the hands of a receiver. It operates 11,000 miles of track and has a capital of over 667 million dollars. The directors claim that a main factor of the situation has been the competition of the Panama Canal, with the low freight rates of the latter from the Atlantic seaboard to the Pacific Coast and to the Far East. We would have it also remembered that the Chicago, Milwaukee and St. Paul indulged in two extravagant large outlays a few years ago—it built the Puget Sound extension to the Pacific Coast and converted about 800 miles of its main line from steam operation to electric traction.

IN the early hours of yesterday (Thursday) week, the driver and fireman of a goods train from Castleton to Normanton on the former Lancashire and Yorkshire were relieved by other enginemen at Mytholmroyd. The goods train resumed its journey in the charge of the new men, but at Luddendenfoot, the next station, it ran at full speed into the buffer-stops at the outlet of the loop line on which it was travelling. Both enginemen were killed, and the cause of the accident is not known. It may, however, be assumed that the driver thought he was on the main line, and possibly the signal applicable to that line may have been "off" for another train. That is a mistake that has, comparatively speaking, often been made, and it is an error that is hard to legislate for. The extent of the disaster might, in some cases, have been mitigated by a sand drag instead of buffer stops, but in this case the line is on a steep embankment overlooking the river Calder, and a solid buffer stop is therefore necessary.

THE Government of the Department of Bolivar (Colombia) has resolved upon the construction of the Central Railway under the supervision of the Department of Public Works. The total length of the railway is estimated at 500 kiloms., and the cost of construction, which is estimated at 12,000,000 dollars gold (£2,400,000), will be financed by 6 per cent. bonds of the Department, issued at 85 per cent. A foreign corporation has undertaken to construct the railway line from Cartagena to Medellin, capital of the province of Antioquia, at a cost of approximately 8,400,000 dollars. For each completed kilometre the National Government will pay to the Departmental Government of Bolivar a sum of 15,000 dollars. The line, when completed, will open for Medellin and Bogotá a route of communication to the sea. From the capital to the coast the line will run over the Northern and Carare systems to the Magdalena River, thence by rail to Puerto Berrio, and by the Antioquia Railway to Medellin. An alternative route to the south of the Atrato River, although shorter, was considered but rejected. From Medellin, a line will be constructed extending to the Bolivar Railway, under which name the whole system will be known.

IN opening the case the other day on the London and North-Eastern Bill for the proposed railway from Nottingham to Retford, Mr. Macmillan, K.C., said that part of the proposal was for the abolition of the crossing on the level of the line between Sheffield and Grimsby over the main line to and from the North at Retford. There was, before the grouping of the companies, a peculiar feature about this crossing. On all railways it is the rule that when a junction is made between two companies, the later comer pays not only for the new work necessary, but also for the cost of the upkeep of the signal-box and all the permanent way connections, as well as the signalmen's wages. Now, the Great Northern and the Manchester, Sheffield and Lincolnshire arrived at Retford together in 1849, and through all the years that have elapsed since, it was never decided which company was the later company. Each company regarded itself as the original, and sent the other a bill for maintenance, but evidently that was only formal, as no further action was taken. Eighteen miles south of Retford is another such level crossing, which is interesting for another reason. It is where the Nottingham and Lincoln of the Midland section is also crossed by the North main line of the London and North-Eastern. The latter is by far the more important, but as the Great Northern was the later comer, the London, Midland and Scottish, as successor to the Midland, controls the crossing. The late C. E. Stretton, in his enthusiasm for the Midland, suggested that the Great Northern should have gone over or under the Midland by a bridge to avoid the crossing. Whilst level crossings of railways may be dangerous, it is a satisfaction that Parliament in 1846 did not regard them as such or that splendid stretch of the Great Northern main line would have been spoilt for the sake of a line which has only a dozen or so slow passenger trains a day.

Notes and Memoranda.

AN American lead pencil company has recently introduced a new series of pencils, similar in general proportions to the ordinary drawing pencil, but with "leads" of different colours, such as red, blue, green and yellow.

A SAMPLE of Canadian bentonite has been supplied to a large British soap-making firm, for testing in the manufacture of soap. Heretofore, bentonite from Greece has been generally used for this purpose. Early reports indicate that the Canadian bentonite has been found at least as satisfactory as the European product. Samples of Canadian magnesite are also being submitted to practical tests. Magnesite is noted for its heat-resisting qualities. If the Canadian material should prove successful, large quantities of the mineral will be utilised.

IN bringing power from the Lake Cushman hydro-electric plant now being built by the city of Tacoma, Wash., it will be necessary, according to the *Engineering News-Record*, to carry the 100,000-volt transmission line across "The Narrows," in the lower end of Puget Sound, by a 6240ft. span. The idea of using messenger cables on this long span was finally abandoned, and the contract was recently awarded under a plan which calls for the current to be carried by 1¼in. steel cables. Two three-phase circuits will be carried across the long span and the design is such that in case one circuit is out of use the other can be made to carry the double load without heating the conductors unduly. In doing double duty in this way a single circuit would be carrying about 600 ampères.

IN company with thirteen other States, experiments in rural electrification are being carried on in Michigan, where a committee for that purpose was appointed by the Public Utilities Commission two years ago. This committee is made up of representatives of the Agricultural College, State Department of Agriculture, agricultural publications, electric public utility companies, state grange and other agricultural organisations. G. W. Bissell, dean of engineering, Michigan Agricultural College, is chairman. There are approximately three thousand strictly rural electric consumers in the State at the present time served by distribution lines financed for the most part by the consumers themselves. It is believed that the business will presently be sufficient to justify the companies in building distribution lines.

ACCORDING to statements made in the German newspapers, Norway now occupies the second position in the world as an aluminium producer, the United States being first. As compared with only 6000 tons in 1913, the manufacture of aluminium in Norway last year is stated to have amounted to 22,000 tons, and to have thus surpassed that of Germany, Switzerland, and France. The Norwegian Nitrit Company recently increased its share capital from 5,000,000 kr. to 15,000,000 kr., and proposes to raise its last year's record production of 12,000 tons of aluminium to 15,000 tons this year. The Norwegian Aluminium Company turned out 7000 tons last year, and will presumably be able to increase this quantity in the current year by the utilisation of the water powers in the north. The value of the Norwegian exports of aluminium in 1924 amounted to 62,000,000 kr., as compared with 33,600,000 kr. in the previous year.

IT seems somewhat anomalous in view of the generally recognised depression in shipbuilding throughout the world to state that the tonnage of motor vessels launched during March was far greater than any previous month, and during the first quarter of 1925 many more motor vessels left the ways than in any corresponding period since the oil-engined vessel first made its appearance. The explanation, according to the *Motor Ship*, is that motor shipbuilding has virtually been the saving of the situation, for steamer construction has very seriously diminished, more particularly abroad. Last month, cargo vessels totalling 138,000 tons deadweight—over 76,000 tons in Germany—and passenger liners of 25,000 tons gross were launched, whilst for the quarter just ended the figure is well over 300,000 tons. During March orders were placed for new motor ships of 158,000 tons, which is believed to be a record figure for any month.

AT the annual meeting of the Société de l'Union Minière du Haute Katanga, recently held in Brussels, it was reported that considerable attention was being devoted to the electroytic treatment of low-content copper ores from the company's mines in the Belgian Congo. The results obtained at the experimental station, which has a monthly capacity of 100 tons, had encouraged the directors to proceed with the installation of a first plant for the treatment of ore capable of producing about 30,000 tons per year. Two further units each of the same capacity will be installed at a later date. The plants will be operated by power supplied by a hydro-electric station which is to be erected by an associated concern, the Société Filiale Hydro-Electrique, utilising the power of the river Lufira. In order to meet the ever-growing demand for refined copper, the Haute Katanga Company has also decided to establish, in conjunction with the Société Générale Métallurgique de Hoboken, an electrolytic refinery capable of dealing with about 30,000 tons per year.

A SURVEY of Snake River from Lewiston, Idaho, to Huntington, Ore., a distance of 187 miles, made by engineers of the Geological Survey, shows that in this distance there is a fall of 1321ft., and sufficient flow to make possible the development of over 1,000,000 horse-power of energy. The survey included a study of the divide between the Snake and Salmon rivers. Fifteen undeveloped power sites were studied, which, with the present flow, could develop 1,430,000 horse-power for 50 per cent. of the time and 861,000 horse-power for 90 per cent. of the time. With regulated flow and complete irrigation developments, 1,080,000 horse-power could be developed for 50 per cent. of the time and 750,000 horse-power for 90 per cent. of the time. One project considered includes the making of a diversion dam on Salmon River, a tunnel to Snake River, and a dam on Snake River. As this project would make possible the development in one plant of 910,000 horse-power for 50 per cent. of the time and 636,000 horse-power for 90 per cent. of the time, the site is one of the largest yet undeveloped in the country. The only site developed in this stretch of Snake River is a 12,400 horse-power plant near Copperfield, Ore.

Miscellanea.

IT is reported in the daily Press that a Douglas motor cycle climbed Kop Hill, near Princes Risborough, during the Essex Motor Club trials, at an average speed of over 80 miles per hour.

THE old Regina gold mine in Canada, which attracted much attention some twenty-five years ago, but which has been shut down for the past seventeen years, is to be reopened. The original workings extend to a depth of over 500ft.

THE Sydney steel plant, Nova Scotia, is now producing almost at capacity, and in the past few weeks several departments have set new records for production. The total number of men employed on March 3rd, not including the office staff, was 2116.

THROUGH telephonic connection has been established between Bombay and Delhi, *viâ* Agra, Rutlam and Surat, and the results are said to be very satisfactory. There are three repeater stations, namely, at Agra, Rutlam and Surat, the object of these being to amplify the voice over a distance of 920 miles.

THE Town Clerk of Middlesbrough has been authorised to make application to the Ministry of Transport for permission to borrow £933, one-third of the capital expenditure to be incurred in the provision of new petrol-electric trolley vehicles—or the conversion of the present vehicles—for the Teesside Railless Traction Board.

COKE production has been commenced at the ovens at Fernie, British Colombia, for the first time since the plant was closed down six years ago. There are 128 ovens in operation, and others will be heated as quickly as possible. Coke will be shipped to the Trail smelters again, and business is expected to work back gradually to its former volume.

THE Nottingham County Council proposes to purchase from the Gunthorpe Bridge Company the existing bridge over the river Trent, so that it may be demolished and a new span built across the stream at a site slightly to the east of the present structure. The object is to relieve the traffic from Nottingham going towards the Great North Road.

AN excellent seam of anthracite coal has been reached at the new slant of the Gellyceidrim Colliery, Glanamman. This is the second seam struck within the last few months. Known as the Lower Tyllwyd, the new seam is 4ft. thick. This new colliery, consisting of two slants driven from the surface, was commenced eighteen months ago, and the lower seam now struck was reached at a distance of 510 yards.

THE Durban Navigation Collieries at Dannhauser, South Africa, have, says the *Iron and Coal Trades Review*, recently acquired a large area of coal-bearing ground in the vicinity of their existing property, and it is proposed to open this up by means of one or more new pits of large productive capacity. New plant will be installed at the existing pits, and when the additional colliery is equipped and the new area is in full working commission, the Durban Navigation pits will take high rank amongst the leading coal producers in Natal.

THE London, Midland and Scottish Railway, states the *Electrical Times*, has decided to carry out an elaborate scheme of alteration and building at its Crewe locomotive works. Plans have already been passed, and the work is to begin immediately. The scheme is largely the outcome of the increased size and weight of modern locomotives. The old erecting shops are to be provided with high-speed electric cranes. The remodelling of all the steel plant and the introduction of newer types of appliances are part of the scheme. The alterations will entail an expenditure of nearly £500,000.

ACCORDING to *Indian Engineering*, boring operations, which had been conducted for several months past by the Mysore Government at Ramasudram, a distance of about 8 miles from Oorgaum, across country, and about 18 miles by rail from Bowringpet, have revealed a new seam of coal. With a view to sinking a prospecting shaft, the Mysore Government has requested the Oorgaum Gold Mining Company, Ld., to undertake the work. It is expected that this discovery of coal, if it comes up to expectations, will prove of immense benefit not only to the Kolar gold mines, but also to the railways of South India.

RECENTLY one or two prominent shipowners and shipbuilders have predicted that the shipbuilding revival, when it comes, will be due to an increased demand for motor vessels. According to the *Motor Ship*, there has already been such a revival, but it has occurred in countries other than the United Kingdom. On the Continent shipbuilding prospects have improved, owing to the large number of motor vessels that have been laid down, for it is estimated that 75 per cent. of recent orders have been for oil-engined craft. At the end of 1924 the motor tonnage under construction was 923,738, and this has now increased by about 25 per cent. There are over 200 large oil-engined ships on order, including twenty passenger liners of 255,000 tons gross, whilst about thirty steamers of 250,000 tons deadweight are being, or will soon be, converted to motor vessels.

IT is announced by the Post Office authorities that the prize offered for the most suitable design for telephone kiosks has been awarded to Sir Gilbert Scott. The design has been submitted by the Post Office to the Metropolitan Boroughs Standing Committee as an alternative to the concrete kiosk, and it has been accepted. The kiosks will be made of cast iron sections assembled on the site, and will be just over a yard square inside and 8ft. 6in. high overall. The door will be of teak, and the window openings in two sides and the door will be divided into eighteen small panes. An electric lamp will be fixed in the centre of the ceiling to light the interior of the kiosk and also to illuminate the word "Telephone," which will appear on the four sides in dark blue letters on an opal ground. The first of the kiosks should be ready in about eight weeks, and will probably be erected in Kensington, but it will be some months before they are erected in considerable numbers.

NEW IRON FOUNDRY AT DARNALL WORKS, SHEFFIELD

DAVY BROTHERS, LIMITED, SHEFFIELD, ENGINEERS

(*For description see page* 374)

FIG. 5 MAIN BAY VIEW SHOWING CASTING PITS, SAND PLANT AND TELPHER

FIG. 6—MAIN BAY VIEW SHOWING CUPOLAS, CHARGING PLATFORM AND STOVES

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THE ENGINEER.

APRIL 3, 1925.

Australian Naval Defence.

Coming as it does at a time of profound depression in the shipbuilding and allied trades, the order for two large cruisers for the Australian Navy, which, according to reports from Australia, have been placed with John Brown and Co., Ltd., of Clydebank, has been hailed with satisfaction throughout the country. The approximate value of this contract is £4,250,000. It has been stated also that Vickers Ltd., of Barrow, have taken an order from the Australian Government for two submarines, to cost £716,340 together. The caution with which we speak of these orders will not escape attention. As a matter of fact, they are, at the moment of going to press, enveloped in some mystery, and we have been unable to ascertain that either of the orders has been actually placed. Indeed, there are rumours that the contract will not appear in this simple form. It seems, however, to be certain, from a statement made by Sir Joseph Cook at the dinner of the Institution of Naval Architects on Wednesday night, that the orders will be placed in this country, and British industry will, therefore, benefit to the extent of nearly £5,000,000 by Australia's decision to reinforce her naval squadron. Not less than 60 per cent. of this large sum will be paid out as wages, and many districts other than the Clyde will share in the distribution, for the arming and equipping of a modern warship involve the placing of sub-contracts over a very wide area of industrial Britain. If the order for the cruisers is confirmed, we shall have to congratulate John Brown and Co., Ltd. on having obtained the most valuable naval contract which has been awarded to any firm in this country since the peace. The same company, it is true, was to have been entrusted with the building of one of the four battle-cruisers authorised under the Navy Estimates of 1921, but all these vessels were subsequently cancelled by the Washington Naval Agreement. The total cost of the two Australian cruisers will exceed by at least a million that of a first-class battleship of the pre-war era. It is understood that the vessels will be indentical with the five "County" cruisers now being built for the Royal Navy—three in State and two in private yards. The two Commonwealth submarines which, it is reported, will be constructed by Vickers Ld., have previously been described as vessels of the ocean-going type, with a cruising endurance of 3000 miles. They will, of course, be much smaller than the huge submarine X 1, but it is a striking fact that their collective cost will be £200,000 below that of the former vessel. The expenditure of more than £900,000 on a single submarine, admittedly of a novel and untried design, has yet to be justified by results.

It was only after prolonged consideration that the Australian Government decided to have its four new vessels of war built in Great Britain. Its political opponents did their utmost to thwart this resolve, but economic facts proved too strong for them. At no time, we understand, was there any question of building the submarines in Australia. Not only do these boats represent a highly specialised branch of construction, but since their design embodies many features which the Admiralty regards as confidential, it appears to have been thought that Imperial interests would best be served by having the work done here. It was in regard to the cruisers that a battle royal had to be waged by Mr. Bruce and his supporters. Local interests demanded that at least one of the ships should be constructed in Australia. Two of the existing cruisers of the Commonwealth Fleet were built at the Cockatoo Island yard, Sydney, it was pointed out, and there seemed on the face of it no adequate reason why one, if not both, of the new vessels should not be built by Australian labour. But on going into figures the Government soon discovered a powerful objection to this course. When the lowest British and the lowest Australian tender were compared, the latter was found to be about £400,000 higher than the former. By placing both the orders in Great Britain, a sum of £800,000 would thus be saved, and that step, it appears, has accordingly been taken. Though the Government's critics may not be silenced, public opinion in the Commonwealth generally is sure to approve a decision clearly dictated by sound economic sense. It is not often that so high a degree of moral and political courage is shown by a party administration in any country. The £800,000 saved by this wise resolution is to be invested in a seaplane carrier of Australian construction. When all the new vessels are ready for service the Commonwealth Navy will have received a substantial addition to its fighting strength. Few of its present ships are of modern design, and although expensive to maintain, they afford scant protection to a State which is dependent on sea power for its existence. But modern ships of war are so costly that it would be quite impossible for Australia, under present conditions, to keep up a fleet of the dimensions of her pre-war establishment. The most she can do is to provide herself with a limited number of vessels suitable for commerce and coast protection, while continuing to rely upon the Royal Navy as her sure shield against aggressive action by some powerful enemy. Circumstances are combining to promote the cause of Imperial naval unity, which is symbolised by the projected base at Singapore. For many years now Australia has clung tenaciously to the principle of independent control over such armed forces as she maintains at her own expense, and her claim in this respect is unreservedly admitted by the Home Government. But the most patriotic Australians readily concede the importance of standardising the naval armaments of the Empire—alike in organisation, training, and material—so that in time of crisis all these forces may coalesce into a strategical unit. By this system adequate protection is at all times assured to the Overseas Dominions no less than to the Mother Country, and we are of those who look forward with confidence to the day when the burden of defence, hitherto supported in great measure by this country alone, will be apportioned more equally among the peoples of the Empire. It is not too much to hope that the fine example set by Australia in building up a new naval squadron will encourage other Dominions to take similar action. New Zealand, whose resources are not yet equal to a shipbuilding programme, has generously offered to defray the maintenance charges of a second cruiser. During the autumn, therefore, the Diomede will join the Dunedin for service in New Zealand waters. The naval policies of Canada and South Africa have yet to be defined, but in both countries the recent visit of the Special Service Squadron appears to have stimulated popular interest in this question, and a section of the Canadian Press is urging the need for a more active policy in relation to naval defence.

In connection with the new Australian contracts, it is of interest to recall the fact that John Brown and Co., Ltd., were the builders of the battle-cruiser Australia, the first flagship of the Commonwealth Fleet. Delivered in 1913, this fine vessel played a useful part in the war, serving first in the Pacific and latterly with the Grand Fleet in the North Sea, though she had the misfortune to be in dock when the Battle of Jutland was fought. Her career was terminated by the Washington Treaty, pursuant to which she was sunk outside Sydney Harbour last year. When the two new cruisers are

commissioned, the Melbourne and Sydney will probably be laid up or scrapped. Both date from 1912, and their speed of 25 knots is much below present-day requirements. The Brisbane and Adelaide are of the same class, but of later construction, and may therefore be retained on the active list for some years to come. The only other effective combatant ships are six destroyers, which were presented to the Commonwealth by the Home Government in 1919. Apart from the delay in completing the Singapore base, Japanese naval progress was probably a factor in determining the Australian people to put their sea defences in order. Although the Empire's relations with Japan are of the friendliest, it is rightly felt that steps must be taken to restore the balance of power in the Pacific, where British interests are so extensive and important. When her building programme matures a few years hence, Japan will possess twenty-five cruisers of modern design, all of which are 6 to 8 knots faster than any of the existing Australian ships. Japan will also have a very large flotilla of ocean-going submarines, and, behind these skirmishing forces, the third largest battle fleet in the world. Compared with this formidable aggregation of power, the Australian programme can hardly be described as ambitious. Like the British Government's decision with regard to Singapore, it has been prompted solely by defensive considerations. Under no conceivable circumstances could either the Singapore base or the Australian Fleet represent a menace to the Power that enjoys undisputed command of the north-western area of the Pacific Ocean.

The Future of the Marine Steam Engine.

On a tonnage basis one merchant vessel out of every three of those now eing built in the whole world will, when put into service, be driven by internal combustion engines. From this prime fact we infer that whatever engineers and shipbuilders may think or say regarding the technical merits of the heavy oil marine engine, the world's shipowners are largely satisfied that the motor ship is no longer an experiment, and that it possesses definite advantages over the steam ship. It may be assumed with confidence that the shipowners have a solid basis for their faith in the motor ship, and that it is not inspired by the prevailing depression in their industry and a desire to seize any opportunity, however desperate, of improving the outlook. The situation is a remarkable one, for while the shipowners are substantiating their faith in the motor ship in a most practical manner, marine engineers and shipbuilders are still far from unanimous in their views regarding the heavy oil marine engine, and indeed are still, in this country at any rate, to a large extent engaged upon its technical development. In brief, the position is the very reverse of what, on its prime facts, it ought to be. The subject divides itself into a consideration of the slow-speed cargo type of ship, and a consideration of the fast high-powered passenger vessel. As regards the slow-speed vessel of moderate power, it is to be observed that while the big majority of the motor ships now in service or under construction are of this type, marine engineers have only just begun to determine its merits on a basis of precise measurements, and are still very uncertain as to what their verdict will be. As regards the fast passenger motor liner, the position is that while one, the Aorangi, has been completed and put into service, and others of a similar size are being completed, authoritative opinion on the engineering side has been expressed to the effect that such vessels exceed or mark the limit of the useful application of the internal combustion engine for marine propulsion. On the one hand, we have the views of Sir George Goodwin and those who agree with him that at present there is no reason to suppose that the requirements of vessels, other than submarines and mercantile ships of moderate powers, will ever be adequately met by internal combustion engines of the reciprocating type. On the other hand, we have the school of thought expressed recently by Sir Fortescue Flannery and Lord Bearsted which holds that, except for some special purposes, the steam engine as an instrument of marine propulsion is rapidly dying.

In the paper which Sir John Biles read at the opening meeting of the Institution of Naval Architects, and which we reprint elsewhere in this issue, some important considerations are to be found which must be weighed with care if we would justly appraise the situation. Sir John will not admit that the marine steam engine is dead or even dying. Comparing the Aorangi with an actually existing oil-fired steamer with double-reduction turbines, he admits that the steamer burns more than twice the amount of fuel consumed by the motor ship per shaft horse-power hour, that for equal voyages it has to carry three times the weight of oil and water, and that the area of the machinery openings in the decks is 10 to 11 per cent. greater. He argues, however, that the extra space occupied by the machinery in the steamer could be recovered by increasing the length of the vessel by a mere 4ft. or so, and that the increased weight of fuel and oil carried is to some extent set off by the increased mean gain in speed secured during the voyage by the progressive reduction of the weight carried. Tackling the main problem, that of the high fuel consumption of the steamer, he argues that the adoption of certain modern land power station practices on board the steamer would raise the overall thermal efficiency to a value not much inferior to that of the best heavy oil equipment, and would give a strongly competitive commercial efficiency. The power equipment visualised by Sir John embraces the use of triple-expansion turbines, driving through a combination of double and single reduction gearing, and taking a supply of high-pressure superheated steam—500 lb. and 700 deg. Fah.—from oil-fired water-tube boilers equipped with waste gas air pre-heaters and exhaust and bleeder steam feed-water heaters. With such an installation he foresees a steam consumption not exceeding 6.9 lb. per shaft horse-power hour. He is supported in his claims for such an equipment by the views of Sir Charles Parsons as to its practicability, and by the fact that Messrs. Babcock's, Yarrow's and Howden's have built, or are building, marine boilers of the class indicated, or something very similar thereto. Comparing two 20-knot, 27,000 shaft horse-power vessels, one equipped with heavy oil engines and the other with high-pressure turbines on the plan outlined, he estimates that on a double journey across the Atlantic the steamer would show to advantage, to the extent of 1052 tons in the weight of machinery, fuel and water to be carried. In arriving at that figure Sir John, it should be noticed, deducts from the economy of weight shown by the steam machinery only half the weight of the extra fuel and water which the vessel would have to carry, the object being to present the advantage in the mean state of the vessel during the voyage. On the financial side, it is estimated that the cost of the machinery would lie handsomely to the advantage of the steamer, and that the annual charges for interest, depreciation, &c., would show a proportionate reduction. Under the heading of running expenses, the steamer would cost more per year for the fuel consumed, for the feed water used and for the wages paid to the engine-room staff, but would save a considerable sum on lubricating oil. All told, the annual sum involved in meeting the running expenses and charges would be £13,000 less for the steamer than for the oil-engined vessel. It is not without interest to note that this saving can be almost wholly accounted for by the extravagance of the oil engine in the matter of lubricating oil, and that the sum charged against this item for the motor ship, £11,554, is actually in excess of the annual wages paid to the engine-room staff. It would appear, too, that the economy estimated for the steamer is sensibly affected by the speed of the vessels compared. If the speed is changed from 20 to 17 knots, the saving per year is reduced from £13,000 to £7000. From these figures we may estimate that for vessels of between 13 and 14 knots speed the saving would entirely disappear.

The direction and tone of the discussion on Sir John's paper surprised and disappointed us. With perhaps two shadowy exceptions, all who took part in it united in praise of the steam engine for marine propulsion, and in rejoicing at the evidence provided by the paper that its day was not yet over. For some reason, at which we can only guess, those who might have supported the heavy oil engine either did not attend or remained silent. Yet ample opportunity for presenting an entirely different aspect of the subject was afforded to them. In spite of the fact that we have a very real fondness for the marine steam engine, in spite of the fact that we have not yet grown to love the heavy oil engine as a means of propelling ships, in spite of the chorus of approval heard on Wednesday morning, we are not convinced by Sir John's arguments and figures. At half a dozen different points they might be attacked by the advocate of the oil engine, and converted to an entirely opposite conclusion. In estimating the commercial advantage of the high-pressure turbine system, Sir John bases the cost of the annual fuel bill for the hypothetical motor ship on a consumption of 0.5 lb. per shaft horse-power per hour. On her trials, as he himself records, the Aorangi used less than 0.45 lb. for the main and auxiliary engines together, and on her first voyage, as her logs show, she used 0.46 lb. for all purposes. If we take the latter figure as correct, it would produce a reduction in the annual estimated cost of running the hypothetical motor ship at a speed of 20 knots, almost sufficient to wipe out the whole of the advantage alleged to be possessed by the high-pressure turbine ship. Accompanied by a slight reduction in the very extravagant lubricating oil consumption set against the motor ship, the annual cost of steamer would become greater than that of the motor ship. Again, in the matter of cost of the fuel, Sir John bases his estimates on a charge of £4 per ton for "Diesel" oil and £3 5s. per ton for boiler oil. Heavy oil engines have already been constructed to run on boiler oil, between which and "Diesel" oil there would appear to be no essential physical difference. If, instead of taking the premium on "Diesel" oil at 15s., Sir John had set it at half that figure, he would have failed to show any saving in the annual cost of the steamer.

The saving in the annual cost attributed to the steamer depends, it will be found, entirely on the alleged lower relative first cost of the machinery, for its running costs are actually entered at some £10,000 more than those of the motor ship. Sir John bases the cost of the oil engines on a figure of £17 per shaft horse-power, and that of the steam machinery on one of £12 5s. That difference may prevail to-day, but it is bound to decrease when the manufacture of oil engines becomes as thoroughly established as is the production of steam machinery. The charges for interest, depreciation, insurance and maintenance are in both cases calculated at 18½ per cent. on the cost of the machinery, a fact which seems to indicate that in Sir John's opinion there is little to choose between the reliability of the two classes of plant, a point which might have been used with effect by an oil engine advocate to combat the suggestions made during the discussion that the situation was otherwise. Much, too, might have been made of the question of complexity, for it is evident that with the additions proposed by Sir John, the outstanding advantage of simplicity possessed by the steam engine would be wholly destroyed. The argument adopted in connection with the alleged saving in weight carried by the steamer might also have been attacked, for that saving, being based on half the weight of fuel and oil used on the voyage, is not effective at the start, and cannot therefore be used for the accommodation of additional cargo, unless such cargo can be taken in at an intermediate port and stored in the bunkers or water tanks. Neither can the weight saved be properly translated into terms of additional power of machinery, unless a corresponding sacrifice is made of initial carrying capacity. These and other matters might have been dealt with by the oil engine advocates, had they taken part in the discussion. Whatever may have been the reason why they were absent or silent, it is to be trusted that it did not spring from a half-hearted interest in a form of marine prime mover which, no matter whether we like it or not, is being wanted each year in increasing numbers, and which is being developed and applied with enthusiasm and vigour by foreign competitors.

Obituary.

HENRY EDWARD JONES.

Mr. Henry Edward Jones, whose sudden death, at the age of eighty-two, occurred at his country home, Marden Ash, Ongar, on March 24th, had for many years been regarded as the *doyen* of the gas industry, in which, during the greater part of his long and active life, he was a forceful and outstanding figure. Mr. Jones was almost the last survivor of a small band of veterans in whose keeping the interests of the towns' gas industry have lain for the past half century, amongst his distinguished co-workers and contemporaries being Sir George Livesey, Sir Corbet Woodall, William Newbigging, A. F. Phillips, and Charles Hunt. During his later years it was mainly in connection with the administration of gas undertakings, not only in this country, but in many parts of the world, that Mr. Jones was known, and his services were in great request in the Committee rooms of the Houses of Parliament as an expert witness whenever Bills and Orders relating to the supply of gas were under discussion. The vigour with which he expressed his views, and the obstinacy with which he adhered to his convictions, gained for him the

reputation of an invaluable expert witness, and there is no question that once his mind was made up as to the justice or expedience of some particular cause, which he had set out to further, he was never content to rest until his purpose had been accomplished. The secret, in fact, of his striking success in his own particular sphere was an unlimited capacity for work, coupled with the gift of inspiring those who served him to give of their utmost and best.

Mr. Jones was more or less cradled in the gas industry, for he was the son of Mr. Robert Jones, who, from 1854 to 1881 was chief engineer to the Commercial Gas Company, the great undertaking which at present supplies seven square miles of the East End of London and a population of approximately half a million. His preliminary training was carried out in the locomotive shops of the London and South-Western Railway Company, but once the principles of mechanical and civil engineering were acquired his activities were deflected to the gas industry, and in the early 'sixties he was appointed engineer to the Wandsworth Gas Company. From then onwards promotion followed promotion, until in 1880 he became chief engineer of the Commercial Gas Company on the retirement of his father. This appointment, combined with close connection with many other undertakings, either as consultant or director, he held until 1903, when he was succeeded by his son, Mr. Stanley H. Jones, M. Inst. C.E., the present general manager of the company.

During the past quarter of a century Mr. Jones' interests in the gas industry were continually widening. Apart from the influence he exerted as consulting engineer to innumerable undertakings he was, on account of the technical and financial success of the concerns with which he was connected, invited to join the directorates of a number of companies. At the time of his death he was deputy chairman of the Commercial Gas Company, chairman of the Wandsworth Gas Company, of the Bombay Gas Company, of the European Gas Company, and of the Primativa Gas Company of Buenos Aires. From the engineering societies and technical institutions honours naturally came freely, although as a contributor to technical proceedings Mr. Jones was remarkable for a reticence which can readily be explained by the busy life which he led. It was, however, greatly to his credit that he was almost the sole gas engineer of the old school who kept the principles and practice of gas engineering in the view of the Institution of Civil Engineers, and it is largely owing to his influence that this at-one-time rather despised branch of engineering has come to be regarded as a worthy and indispensable factor in the amenities of everyday life. His work in this direction was rewarded by a Telford gold medal, a Telford premium, a Stephenson medal, and a Watt medal, while he undoubtedly found the culmination of his ambition in his election as president of the "Civils" in 1917. This, it is worthy of note, was the first and only occasion on which a gas engineer has occupied the presidential chair of the premier engineering institution of the world.

In 1904 Mr. Jones was president of the Institution of Gas Engineers, and at a later date founded the London medal of that institution, which is awarded, at the discretion of the Council, for any outstanding paper dealing with gasworks engineering and design. There can be no doubt that his ripe and diverse experience in both technical and administrative directions will be sadly missed by the somewhat highly specialised industry which he so diligently served. By his technical colleagues of his own generation he was regarded with unusual affection, and, though at times the younger members of the profession may have smarted under his lash, they will not fail to retain for him a respect which was his due, fully appreciating that, when his condemnation was incurred, it was the natural outcome of his zest for work, and that there was usually justification for it.

T. J. REYNOLDS.

THE death is announced as having taken place on Monday, March 23rd, of Mr. T. J. Reynolds, who for many years had been in charge of the installation of all turbo-generator plant manufactured by the British Thomson-Houston Company, Ld.

Mr. Reynolds, who was the second son of the late Major T. W. Reynolds, R.A.S.C., was born at Aldershot on December 8th, 1876. He was trained in the steam and mechanical engineering departments of Combe, Barbour and Combe, Ld., Belfast, and after many years in the merchant service—P. and O. Steam Navigation Company and Ocean Steamship Company, Liverpool (Alfred Holt and Co.)—he joined the B.T.H. Company's construction staff, being placed in charge of his department in 1913. For the past twenty-two years Mr. Reynolds had been closely identified with the turbines of that company, and he was recognised as having unique experience and skill in their installation and maintenance. His death will be greatly regretted, not only by the company to which he had been a faithful servant for so long, but also by very many central station and other engineers throughout the country, amongst whom he was widely known and very highly respected.

SAMUEL PETER AUSTIN.

THE death of Mr. Samuel Peter Austin, head of the Sunderland shipbuilding firm of Austin and Sons, took place at his home, Holin Hall, near Ripon, on Wednesday, March 25th. Mr. Austin started work early in life and went right through all the ramifications of the shipbuilding business, so that when he succeeded his father in the control of a slipway near the Wearmouth Bridge at the age of twenty-five he was well equipped to carry on the business, and it prospered until it included several berths, a dry dock and a pontoon. He was one of those who preached and practised the doctrine that capital and labour should work hand in hand, and was connected with many philanthropic institutions, besides being a director of the Sunderland Gas Company and a Justice of the Peace. Mr. Austin, who was eighty-two years old at the time of his death, was predeceased by his only son.

Literature.

Sewage Disposal in India and the East. By GEORGE BRANSBY WILLIAMS, M. Inst. C.E. Calcutta and Simla: Thacker, Spink and Co. 1924. Price 10/8 rupees.

MR. BRANSBY WILLIAMS, in addition to other qualifications fitting him to write such a volume as that under consideration, is Chief Engineer to the Public Health Department of the Government of Bengal. He has, therefore, had exceptional opportunities of studying the problems he discusses. As a matter of fact, in perusing his book, the reader is constantly being reminded that the author is well acquainted with local conditions. We must confess, therefore, that at the outset we were inclined to wonder why so many references—some of them of considerable length—are made to sewage disposal plant and apparatus at work in countries, the climates of which are very different from that of India, since methods of sewage disposal, which are quite suitable for temperate climates, may be inapplicable in tropical and semi-tropical climates. Mr. Williams' purpose, however, has, so he states, been to give as complete an account as possible of the various systems of sewage disposal that have been adopted from time to time in other parts of the world, and to explain the reasons that make some of these processes more particularly suitable to the East, with or without modification. As a result, he has succeeded in producing a book which is eminently readable, though there are perhaps portions which might have been omitted without detracting from the general utility of the work. For example, a good deal of the first chapter, which is almost entirely historical, might well have been left out. However, that is a small matter.

Chapter II. deals with the chemistry of sewage, and in it the difference between Indian and European sewage and the methods of chemical analysis employed in disposal works, are discussed. In Chapter III. the author proceeds to review the nature of the changes undergone by sewage during the process of purification, and to compare standards of purity required for effluents in England and India. "The conditions in India," we read, "render the laying down of any general standard of chemical purity an impossibility at present It would seem that a considerably lower standard as regards nuisance produced by sewage effluents might be reasonably insisted on in most places in this country [India] than in England. In the former country the ordinary nuisances to be met with in the towns and their surrounding country so far transcend anything that the ordinary inhabitant of present-day England can imagine, that the nuisance from even an unsuccessful sewage purification works would seem mild in comparison. Nevertheless, the persons who tolerate the abominable condition of privies that are cleaned once a week, or, in many cases, not at all, or the procession of conservancy carts, that are to be met with at all times of the day in narrow streets and thickly populated areas, are the first to raise a clamour if the slightest smell reaches them from a sewage works. A further uncertain factor in the problem of sewage disposal is the interpretation that may be placed upon the legal definition of a 'nuisance' created by a sewage works, by the Indian courts of law. The result of any litigation in India is even more a matter of chance than in England, and it is quite conceivable that Indian judges might require a standard of purification which it would be found impossible to attain in practice."

Chapter IV. is devoted to simple methods of sewage disposal, such as by the use of privies, by the dumping into sewers, by cesspools, &c.; and then the author passes on to treatment processes. Preliminary treatment is dealt with in Chapter V.; settlement with or without chemicals in Chapter VI.; septic tanks in Chapter VII.; and two-storied tanks in Chapter VIII. "The Discharge of Sewage into Tanks, Rivers and Tidal Waters" forms the subject of Chapter IX.; "Sewage Irrigation" of that of Chapter X.; and "Contact Beds and Percolating Filters" of Chapter XI. Chapter XII., which runs to thirty pages, is concerned with the activated sludge processes, and is one of the best in the book. With regard to the applicability of this method of sewage treatment to Indian conditions, Mr. Williams remarks that its field is limited by economic conditions. "With a 15 gallons sewage," he states, "the cost to an Indian municipality (including interest on, and repayment of, capital at current rates) would work out at about 14 annas per head per annum. This is . . . nearly as much as the amount an ordinary moffussil town can afford to spend on the whole of its sewerage, drainage and sewage disposal, including construction of sewers, outfall works, maintenance and conservancy. The possibility of introducing the system, therefore, seems to depend on obtaining an income from the manurial value of the sewage treated, and the sludge produced, that would compensate for the costly nature of the process." "There are, however," he continues, "other questions to be considered before it can be said that the activated sludge process is suitable for Indian towns. An important one is as to how far the large quantity of detritus and mineral matter in the sewage of some of the Indian towns, and the highly septic condition of this sewage will affect the cost and efficiency of the process, and an equally important point the necessity for skilled expert supervision, which it is impossible to expect that sewage works in India will obtain."

The subjects dealt with in the two succeeding chapters are:—Chapter XIII., "Sewage Disposal: Trade Effluents," and Chapter XIV., "Domestic Sewage Disposal: Sterilisation of Effluents," while the final chapter—No. XV.—is set aside for "General Considerations." In the latter the author says that the final conclusion that must be arrived at is that the prospects of improved systems of sewage disposal being introduced into oriental towns depend largely upon a general education of the inhabitants and their elected representatives in the economic value of the works required. It will, first of all, be necessary to convince them that the reduction of death-rate and sickness which results from a modern sanitary system is appreciable. It must, he says, be supposed that systems of sewage disposal on modern lines will eventually become as general in towns in the East as in the West. "So far," he adds, "as India is concerned, certain general propositions may be laid down regarding the type of sewage disposal suitable. It may be assumed that whatever system is adopted, the first consideration will be that it should be most economical, consistent with efficiency in operation. Having regard to the fact that India is predominantly an agricultural country, it may be definitely stated that the most satisfactory system is one that will return the nitrogen in the sewage to the land as manure for the crops, whilst the long periods of drought make the utilisation of the water in the sewage for irrigation purposes an obviously desirable object."

Of the volume as a whole, we may add that we have read it with a considerable amount of interest. We are somewhat surprised, however, that more attention is not devoted to the question of gas production. Only two pages are set aside for it. It is true that the Matunga Leper Asylum plant is mentioned, but only seven lines are given to it, and no reference whatever is made to the excellent work there of Mr. C. C. James, nor to his book "Drainage Problems of the East," which deals with very similar subjects to those discussed by Mr. Williams.

BOOKS RECEIVED.

Di un Nuovo Tipo di Legante Pozzolanico. By F. Ferrari. R. Scuola d'Ingegneria, Pisa, No. 1. Settembre, 1924.

Lo Stato Attuale dei metodi di Rilevamento Topografico dagli Aerei. By G. Cassinis. R. Scuola d'Ingegneria, Pisa, No. 4. Settembre, 1924.

Livellazione Geometrica di Precisione della città di Viareggio (Eseguita nel Settembre, 1924). By G. di Ricco. R. Scuola d'Ingegneria, Pisa, No. 5. Settembre, 1924.

Experiments in the Use of Back Pressure on Oil Wells. By T. E. Swigart and C. R. Bopp. Washington: Superintendent of Documents, Government Printing Office. Price 15 cents net.

Annali dei Lavori Pubblici già Giornale del Genio Civile. (Ministero dei Lavori Pubblici, Consiglio Superiore). Anno LXIII. N.1. Gennaio, 1925. Rome: A. de Gaetani, Via Torre Argentina, 47.

Illustrated Technical Dictionaries. Vol. XV., Spinning: Its Processes and Products. Edited by Alfred Schlomann. London: Lewenz and Wilkinson, Ld., 25, Victoria-street, S.W. 1. Price 41s. net.

L'errore di situazione dei Punti determinati con procedimenti aerofotogrammetrici e i metodi di Triangulazione Aerea. By G. Cassinis. R. Scuola d'Ingegneria, Pisa, No. 6. Settembre, 1924.

Einfluss der Fliehkräfte auf Eisenbahnbrücken. By Dr.-Ing. O. Kommerell and Bruno Schulz. Berlin: Wilhelm Ernst und Sohn, Wilhelmstrasse 90, W. 66. Price 2.10 gold marks.

Conditions Affecting the Activity of Iron Oxides in Removing Hydrogen Sulphide from City Gas. By W. A. Dunkley and R. D. Leitch. Washington: Superintendent of Documents, Government Printing Office. Price 10 cents net.

Department of Overseas Trade: Report on the Industrial and Economic Situation in Chile, September, 1924. By Mr. W. F. Vaughan Scott, Commercial Secretary to H.M. Legation, Santiago. London: H.M. Stationery Office, Adastral House, Kingsway, W.C. 2. 1925. Price 3s. net.

Misure balistiche di Valori massimi di grandezze alternative per mezzo dei diodi, and *Variazioni di temperatura e di emissione elettronica di un filamento di tungsteno reso incandescente da corrente alternata.* By M. Paris. R. Scuola d'Ingegneria, Pisa, Nos. 2 and 3. Settembre, 1924.

Water Softening Plant at Ellesmere Port.

A SHORT time ago we were invited to inspect a water softening plant which has been erected at the corrugated iron sheet works of Burnell and Co., Limited, Ellesmere Port, by Wollaston Gas Producers (Manchester), Limited, for treating water obtained from the canal in order to make it suitable for use in Lancashire boilers. In addition to being fairly hard this water contains much organic and greasy matter. The analysis of the dissolved solids contained in the water is as follows :—

	Parts per 100,000.
$CaSO_4$	5.59
$CaCO_3$	9.99
$MgCO_3$	2.95
NaCl	4.76
Fe_2O_3	0.30
SiO_2	0.52
Total	24.11

The steam-raising plant comprises three Lancashire boilers, each 30ft. by 8ft. 6in., with superheaters and economisers, two boilers only being kept under steam at a time, and the average evaporation is unusually high, namely, 12,500 lb. per boiler per hour, day and night. A section and plan of the softening plant and sketches of some of its component parts are shown in Figs. 1 and 2 respectively. Referring to Fig. 1, it will be seen that the hard water reaches the softener through the pipe A. The water is generally drawn from the hot well of a jet condensing plant and it reaches the softening plant at a temperature of about 100 deg. Fah. Some of the water also comes from other sources within the works. The reagent solution—milk of lime and soda ash—are prepared in the two mixing tanks B B, each of which is provided with a stirring paddle and is capable of running over a twelve-hour shift, so that one is always idle in preparation for the next shift. The solution in the tanks is prepared under constant volume conditions, any variation required in the treatment of the water being effected by alteration of the strength of the reagent solution. The solution is added as required to the raw water in a manner which is described later.

The water with added reagent flows first to a mixing box C, down the pipe D at high velocity to three parts down the reaction tank E, and then slowly upwards in that tank. The makers claim that, during the flow, perfect mixing takes place, and that the grease in the water, emulsified by the reagent, is attracted by the fine solids in suspension and floats to the surface as scum, while the heavy sludge in the reaction tank—the result of earlier softening—is stirred up by the down flow of the incoming water and mingling with it helps to bring down the new and lighter released solids. The treated and still turbid water then passes down the pipe F into the first clarifying tank G, which is connected by a pipe to the second clarifying tank G^1. The water rises slowly and evenly within these two clarifying tanks, which, of course, work in parallel, the two tanks being provided in order to make the flow as sluggish as possible. In the upper part of each clarifying tank is a filter box H made of timber and furnished with framed open bottoms prepared to receive mat filter grids, consisting of cast iron frames over which is sewn a sheet of cocoa-nut matting. The frames make joint with the timber frames by their own weight, and the water rises slowly through the mesh, which is so coarse as to exercise of itself little straining action, but which forms a bed to which the matters in suspension adhere and become a filtering medium. The arrangement, which is well known in the alkali industries, is said to be very efficient. When the mats show signs of excessive resistance they are lifted out and replaced by spares. The fouled mats only need to be dried and beaten to be ready for replacement. In the plant at Ellesmere Port the mats are, we understand, used for periods of six weeks without cleaning. At the filter box outlets K K, are provided adjustable weirs which can be set to ensure that the flow through the clarifying tanks is equalised.

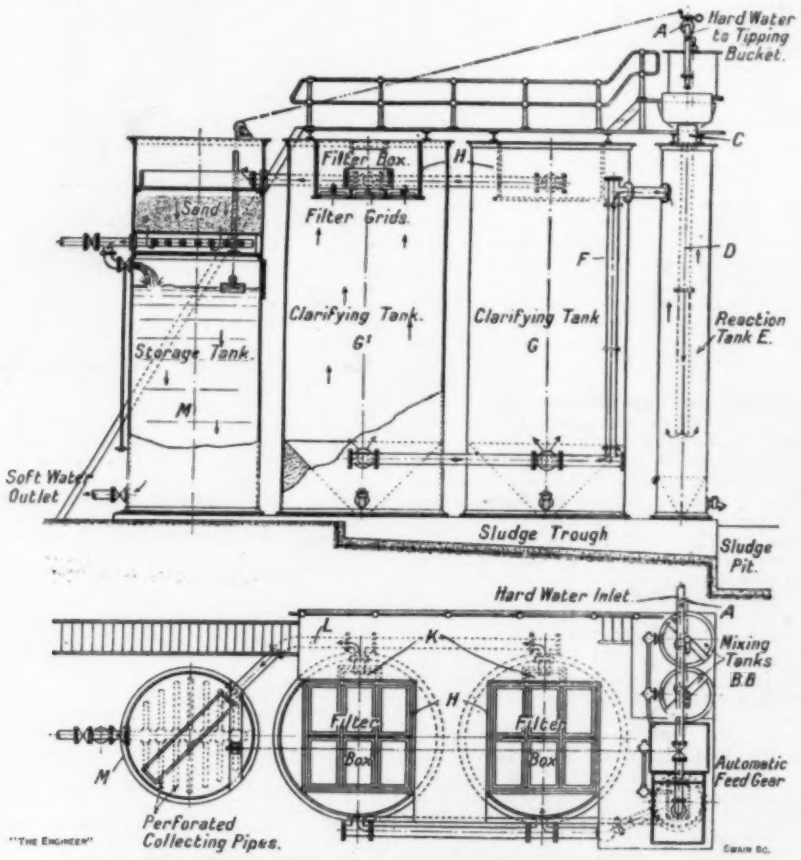


FIG. 1—SECTION AND PLAN OF WATER SOFTENING PLANT

The clarified and roughly filtered water, on leaving the tanks G and G^1 at the top, passes along the pipe L to a filter arranged above the soft water tank M. The filtering material is either sand or quartz. Instead of falling into the storage tank the clarified water can be led directly to the feed water tank. There is nothing novel about the design or construction of this part of the plant, but it may be mentioned that the filtering material is flushed and cleansed when it becomes necessary by forcing softened and pre-filtered water from the storage tank up through it, the fouled liquid being returned to the clarifying tanks for re-precipitation. The sludge deposited in the tanks D, G and G^1 is run off periodically from the bottoms of the tanks, and the collecting pit is so designed that no suspended matter need be turned into the drainage system.

The automatic feed gear possesses one or two interesting features, as will be seen from Fig. 2. It is of the oscillating bucket type, in which the two compartments or troughs of the measuring bucket alternately fill and empty as it rocks. The normal number of oscillations per minute of the plant under consideration is six, but the speed of the mechanism is, as will be understood, regulated by the rate of inflow. The rate of oscillation of the tipping bucket is controlled by an air buffer mechanism so that its movement is steady, deliberate, and without shock. Furthermore, shock is still further reduced by a leaf spring arranged in the bottom of the tank containing the tipping bucket. The swing of the tipping bucket P is through 45 deg., but motion is transmitted to the chemical tank shaft through gear segments, so that the latter is oscillated through rather more than 90 deg. The scoops Q Q are carried by arms, so that they dip alternately into the reagent solution and rise to a position slightly above the horizontal, when the contents flow through their hollow arms to the receiver S and thence through duplicated channels to join the hard water. The scoops deliver exactly the same amount of reagent whatever the level of the contents of the tank may be, and the calculated quantity at each stroke required to treat the volume of water discharged by one of the troughs of the tipping bucket. There are no joints, pins or contacts immersed in the solution. At each oscillation the stirrer paddle agitates the reagent and keeps it well mixed, and hence at constant strength throughout. It is claimed that by means of the buffer gear above mentioned and the adjustable weighted lever R the mechanism may be set to operate with accuracy as a water meter.

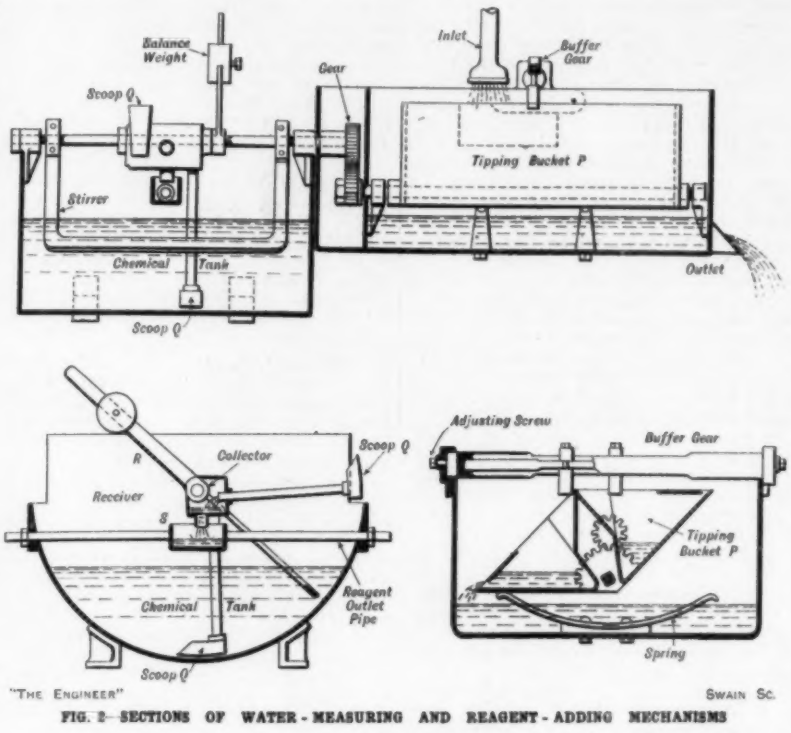


FIG. 2—SECTIONS OF WATER-MEASURING AND REAGENT-ADDING MECHANISMS

This plant is further equipped with a supplementary device for feeding with the lime-soda a minute quantity of copperas solution in order to produce a tractable precipitate. We are informed that so effective has this combination proved that the final sand or quartz filtration is only called upon to operate on rare occasions, as, for example, during the changing of the mat filters.

Prior to the introduction of this softening plant it was not possible to run a boiler at Messrs. Burnell's works for more than fourteen days successively without laying it off for cleaning, while the economiser, after twelve months' work, was found to be almost choked up and the tubes had to be bored out. Since the softener was brought into use some five or six months ago the boilers have been run for periods of eight weeks and seem capable of much longer runs without emptying, while all the scale in the economiser tubes has disappeared. The proprietors inform us that the annual cost of emptying and cleaning the boilers prior to the use of the softening plant was £250 in wages alone, and that they estimate that the cost will now be reduced to £35 per annum.

A NUMBER of suggestions for the prevention of a certain kind of accident in coal mines are made by Mr. Henry Walker, Chief Inspector of Mines, in his report on an explosion which occurred at the Hartley Bank Colliery, Netherton, Yorkshire, last May. The Inspector found that the explosion was caused by firedamp gaining access to the interior of the reversing switch-box of the coal-cutting machine, and there being ignited. Flame thereafter passed out through the hole left by the omission of the set screw and ignited firedamp and air external to the box. As, in the future, the working of coal seams is likely, he says, to depend more and more upon the use of cutting machines driven by electricity, he would like to point out the steps which he considers should be taken to prevent accidents of this character. First, the housing of the electrical parts of the machines should be flame-proof, and so designed that bolt holes or stud holes do not afford a passage to any such part. Secondly, frequent examinations of the machines should be made to ascertain that they are maintained in a flame-proof condition. Thirdly, a generous ventilating current should be caused to sweep the face, or faces, where machines are at work. Lastly, a particularly close watch for firedamp is necessary while the machines are at work.

STEEL HARDENING AND CARBURISING PLANT AT COVENTRY

FIG. 1 BATTERY OF CASE-HARDENING FURNACES

FIG. 2—REAR VIEW OF BATTERY OF HEAT TREATMENT FURNACES

Hardening and Carburising Plant at a Petrol Motor Works.

By the courtesy of Morris Engines (Coventry) Limited, we have recently had an opportunity of inspecting the extensive hardening and carburising plant which has been installed in that company's works by August's Muffle Furnaces, Limited, Halifax. The factory in which the plant is in use, was formerly engaged in the manufacture of the Hotchkiss machine gun, but is now devoted exclusively to the production of engines for Morris cars, and plant has been provided for the large output of 1500 of those power units per week. Quantity production is made possible in this factory, first by the subdivision of operations in the various departments, so that each operation is made as simple as possible; secondly, by providing machines and equipment wherever possible to replace manual labour, and finally by the employment of systems of control and inspection which insure that the products are turned out to predetermined standards of accuracy.

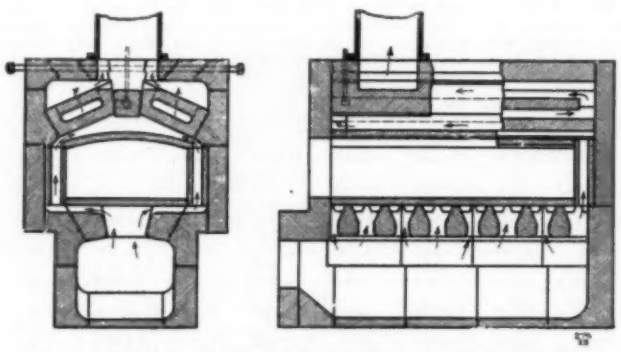


FIG. 3—CROSS AND LONGITUDINAL SECTIONS OF MUFFLE FURNACE

The hardening shops may be taken as typical examples of this remarkable factory. The processes of hardening and carburising steel have been greatly improved during the last ten years or so, and this improvement has been expedited in a very large measure by the demands of the motor industry for materials embodying the greatest strength with the minimum of weight. For this purpose the furnace equipment must be capable of giving uniform temperature conditions, and much foresight has been displayed by the Morris Engines Company in the planning and construction of the building and plant to achieve the desired results. By its permission we are enabled to give illustrations of the plant herewith. Fig. 1 represents a battery of case-hardening furnaces, Fig. 2 is a rear view of a battery of heat treatment furnaces, showng the arrangement of oil pipes and burners, Fig. 3 shows transverse and longitudinal sections through one of the furnaces, and Fig. 4 shows a group of case-hardening furnaces all connected to a common overhead flue by which the products of combustion are taken to the chimney.

The hardening and carburising operations, with which we are specially concerned, are carried on in two separate and distinct departments, so that the treatment of gear wheels is removed from work of a more general nature. The gear hardening section is housed in a well ventilated building illuminated in accordance with high temperature furnace working conditions, and covering a floor area of 3400 square feet, whilst the general hardening department occupies an area of 13,800 square feet, further space being available for future extensions of plant and equipment. The gear hardening department contains seven "No. 15" August standard furnaces with muffle dimensions as follows:—Length, 54in.; width, 28in.; and height, 16in. These furnaces, we are informed, have been in regular work for about six years. There is also one special furnace with internal dimensions as follows:—Length, 8ft.; width, 3ft. 6in.; and height, 18in. This original battery of furnaces has recently been supplemented in the general hardening department by two further batteries, comprising four double "No. 15" standard furnaces 9ft. by 28in. by 16in., five furnaces similar to those mentioned above, and one conveyor type furnace, whilst another furnace is now in process of erection. The whole of this installation is fired with crude oil of .890 sp. gr., which is drawn from tanks of 60 tons capacity, and forced by a drum pump to the atomisers under a slight pressure. The air for the combustion of the atomised oil is supplied by a Keith-Blackman fan coupled to a 6 horse-power electric motor and delivering approximately 3000 cubic feet of air per minute at a pressure of 13in. water gauge.

FIG. 4—BATTERY OF CASE-HARDENING FURNACES CONNECTED TO A COMMON FLUE

Ease of control of the temperature requirements and uniformity of temperature in the muffle proper are essential in an installation of this kind. They are secured by the design and construction of the combustion chamber, which is seen in the sectional illustrations—Fig. 3. The combustion chamber, overhanging at both the front and rear of the furnace, is a feature which conduces to uniformity of temperature and especially to the avoidance of fluctuations at the muffle ends. Furthermore, the design of the furnaces is such that there is an equal radiation of heat from the bottom, top and both ends of the muffle. The efficiency of the insulation of the furnaces is demonstrated by the comparative coolness of the casing, whilst the low temperature of the products of combustion issuing to the chimney demonstrates the overall thermal efficiency. With muffle temperatures of 1000 deg. Cent. the heat of the products of combustion escaping to the chimney is not higher than 300 deg. Cent. We were specially interested in the means of insulation adopted for such high temperatures and are informed that the efficiency is due to a 3in. internal casing of a special heat insulating and refractory material and a protective lining of 1in. asbestos mill board. Portability is another pronounced feature of these muffle furnaces, while accessibility for inspection or cleaning is made possible by the provision of doors.

The Morris Engines Company has proved by continuous tests that as regards fuel cost there is little to choose between liquid and solid fuels, but that there is considerable economy in labour when oil is used, owing to the elimination of the distribution of solid fuel and the removal of ash and cinders, while the order, cleanliness and comfort of the shops when oil is used as fuel are most marked. The requirements of this department are such that the furnaces have to work continuously day and night, a demand which necessitates great stability in the furnace structures. The charged boxes of the various parts to be carburised are introduced and removed from the furnaces on light, although substantially constructed and easily manipulated carriages. The quenching tanks, four in number, in the respective hardening shops approximate in size to 9ft. 4in. by 5ft. 6in. by 6ft. 4in. deep, and contain the quenching media common to the hardening shop, namely, water, brine water and oil. With a view to keeping the temperature of the bath constant at all times, cooling apparatus made by Heenan and Froude, Limited, Worcester, is employed. The principle of its action is the meeting of a spray of warm oil with a current of cool air. An automatic air hoist installation by the Consolidated Pneumatic Tool Company, Limited, effects the movement of the quenched work vertically in the various quenching tanks.

The packing of the work in the boxes with the carburising material is carried out in a roomy shop, apart from the hardening shop proper, and, in the near future, after this operation, the boxes with their charge will be carried by a conveyor direct to the various furnaces, thus reducing the necessity of frequent handling. A shot-blast plant by Tilghmans, Limited, installed in a 6ft. square chamber, is employed for cleaning the gear after treatment.

To enable regular tests and records of the work dealt with to be carried out, test bars machined to standard sizes are treated with each box of parts. These bars are afterwards broken and examined for depth of pentration and to ascertain the physical properties after thermal treatment. Brinell tests are also carried out.

Over thirty years ago the London and North-Western, Lancashire and Yorkshire, Furness, North Staffordshire and Caledonian railway companies set up a code for their telegraph messages on their respective systems and between each other. It was built up on two or three letters of the alphabet. For instance, T Y meant "Meet me on arrival of train at." The weakness of the scheme was that each letter counted as a word, so some of the other companies—the Great Western in particular—adopted a word code. That was considered so greatly preferable that it was universally adopted. On his retirement recently, Mr. C. Gibbs, of the Great Western Railway, said that that company saved £10,000 a year by the use of the code. These code words are frequently used for identification purposes; thus, "Crocodile" means a trolley wagon, and is not only employed in correspondence, but is painted on the trolley wagons, as is "Macaw" on timber trucks.

Steam Engines *v.* Oil Engines for Passenger Ships.*

By Sir JOHN BILES.

Before we decide on the relative merits of steam and Diesel engines for ship propulsion, we have to take into account :—

(*a*) The relative first cost ;
(*b*) The relative cost of Diesel and boiler fuel ; and
(*c*) The relative working costs, including crew and maintenance.

The construction of Diesel engines of large powers has not been sufficiently stabilised or sufficiently extensive to make it possible to standardise the manufacture, so as to ensure the lowest possible first cost. On the other hand, steam boilers and turbines have probably reached very nearly the highest economy of production costs, as they have been produced for many years and in large numbers.

The relative cost of boiler and Diesel oil fuel suitable for ship propulsion seems to be a variable quantity. The difference in cost varies from nothing to 20 per cent. in favour of the boiler fuel oil. It seems probable that for some time to come the oil fuel for the steam engine will be cheaper than for the Diesel.

The cost of the crew for the Diesel engine ship will most probably be less than for the turbine-driven ship in high-powered machinery, but for powers below 10,000 horse-power this does not seem to hold. As to the relative cost of maintenance and repair it is too early to dogmatise. These costs in the case of the turbine and boilers are known and are not high. The number of moving parts of a Diesel engine is very large, and the liability to wear and damage is not small, but until the latest types have been run at sea for some time we must wait for full knowledge on this subject.

As far as can be judged from the data available, it seems to be probable that the turbine will give results in commercial efficiency which will make it a strong competitor with the Diesel.

It is therefore not the Diesel alone which will make existing steamers obsolete, but also developments in the steam engine itself are very likely to produce the same results. The gain in the Diesel over the steam engine is in the smaller consumption of oil per unit of power, but the cost and weight of the Diesel are much greater than the turbine installations using high-pressure high-temperature steam in the way suggested by Sir Charles Parsons in a paper read at the World's Power Conference.

Let us take the case of the latest and only Diesel ship of high speed, the Aorangi, which has been completed, and compare its performance with that of a steamship of about the same dimensions and power, built by the same firm—the Fairfield Company. It happens that this steamship is one of several of about the same size and power built at about the same time by the same and other firms, so that its name need not be stated. These steamships are all oil-fired, with double-reduction turbines. The following are the leading particulars :—

Table I.

	Diesel (Aorangi).		Steam.	
Dimensions	580ft. × 72ft. × 46ft. 7in.		546ft. × 70ft. × 43ft. 3in.	
	Sea.	Measured mile.	Sea.	Measured mile.
Draught, mean	26ft. 5½in.		24ft. 10in.	25ft.
S.H.P.	12,200	12,400	12,050	13,885
Speed, knots	17.91	18.237	17.2	17.96
Displacement, tons	20,740		19,000	19,150
	Diesel (Aorangi). Sea.		Steam. Sea.	
Consumption per S.H.P. /hour, in pounds—				
For main engines	0.395			
For auxiliary engines	0.036			
	0.431		0.984	
Consumption of oil for 3000 nautical miles, estimated from sea trial	393 tons		923 tons	
Estimated reserve feed water used in 3000 nautical miles	28 tons		350 tons	
Total weight of oil and water used in 3000 nautical miles	421 tons		1273 tons	
Mean gain in speed during voyage due to reduction in weight of fuel and oil on board	0.08 knot		0.23 knot	
Equivalent difference in S.H.P. during voyage if vessels run at same speed	1.4 per cent.		4 per cent.	
Area on five decks due to machinery openings	14,000 sq. ft. (about)		15,500 sq. ft.	
Extra length of ship necessary to give same area of decks, exclusive of machinery openings	—		4.2ft.	

It is claimed for the Diesel engine in passenger ships that more space is available for passengers than in the steamships. We may judge of this by observing the relative spaces occupied by machinery openings in the two cases.

Several designs have been prepared for ships of different sizes and lengths of voyage. The types include—(*a*) Diesel engines ; (*b*) steam turbines of existing types of machinery and cylindrical tubulous boilers ; (*c*) steam turbines working at 500 lb. pressure and 700 deg. temperature from water-tube boilers, as proposed by Sir Charles Parsons, called the H.P.T. type.

Weights of Machinery.—The weights of Diesel engines and those of type (*b*) are very much the same. The weight of type (*c*) is from 40 to 50 per cent. less than (*a*).

Consumption per Shaft Horse-power.—It is generally claimed that the consumption of the Diesel is about 0.4 lb. per shaft horse-power for the main engines. It is also claimed that for all purposes in the Aorangi the consumption is 0.45 lb., the difference being due to the auxiliary purposes for which power and steam are used in the ship. The Aorangi has four generating sets, each of 300 kilowatts, and an emergency dynamo, all driven by Diesel engines, two cylindrical boilers, oil fired, supplying steam for oil fuel burning installation, fuel oil transfer and service pumps, piston cooling water pump, auxiliary air compressor, feed pumps, air and circulating pumps for auxiliary condenser, general service pump, ballast pump, forced lubrication pumps, fresh water pumps, watertight doors pump, and a steam-driven dynamo for port use, also steam for the heating system of the vessel.

The amount of steam for auxiliary purposes naturally varies with the kind of auxiliary machinery and purposes to which fuel is applied. In a 20-knot turbine 20,000-ton passenger ship the amount of water evaporated per pound

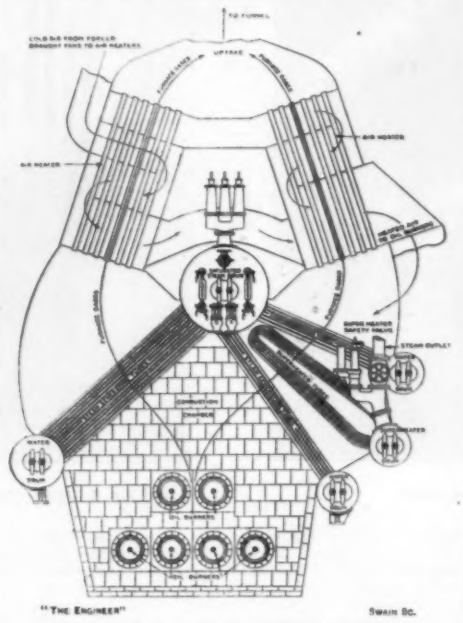


FIG. 1—YARROW HIGH-PRESSURE BOILER

of oil fuel was measured, with the boilers at full power. An estimate of the fuel used for driving the auxiliaries in this ship is 0.15 lb. per oil per hour per shaft horse-power of main engines, and an estimate of the fuel for auxiliaries in a 20,000-ton Diesel ship of 20 knots gives 0.107 lb. per shaft horse-power per hour as the consumption. In the case of the steamship, steam is used only for feed, air, general service, and circulating pumps for main and auxiliary condensers, for cooking, evaporator, ship's heating, brine warming, hot salt and fresh water calorifiers. If 0.45 lb. is used for Aorangi for all purposes, it seems as if either the shaft horse-power at which the ship is running has been over-estimated, or that her auxiliaries are very much more efficient than in other ships. In comparing the Diesel (*a*) with (*b*) and (*c*), the following figures have been used for auxiliaries :—

(*a*) 0.1 (*b*) 0.15 (*c*) 0.1

We may take the consumptions for main machinery as follows :—

(*a*) 0.4 (*b*) 0.9 (*c*) 0.6

With sea water at 60 deg. and vacuum 28in., the totals for all purposes will be :—

(*a*) 0.5 (*b*) 1.05 (*c*) 0.7

water is found to be as much as 4 tons, no evaporators being used. In Diesel ships, the amount is small and may be taken at about 0.3 ton per 1000 horse-power per day. This amount will be increased if fresh water is used in circulation for cooling parts of the engine. This large difference between the steam and Diesel engines can be reduced by the use of evaporators. In the steam system (*c*) it is assumed that 2 tons per 1000 horse-power per day will be sufficient, together with evaporators capable of giving another 2 tons if required.

Total Weight of Machinery, Fuel and Make-up Feed Water Carried.

The weight of fuel and feed water will vary with the distance between fuelling ports. Table II. gives the totals for these items for different types of machinery, and for two distances, 6460 miles and 3230 miles. It will be seen that for the longer distance the Diesel and the high-pressure turbine—or H.P.T.—type are tending towards the same total weight, while the present turbine type is about 50 per cent. more, the ratios being 1, 1.5, and 0.94. For the shorter distance the ratio is 1, 1.28 and 0.81 for the (*a*), (*b*) and (*c*) types respectively. The mean displacement on the voyage will be affected by the consumption of fuel, &c., to the extent shown in Table II. The corresponding ratios of the mean weight for the two distances are 1, 1.28 and 0.81 for the 6460 miles run, and 1, 1.14 and 0.72 respectively for the 3230 miles. No account is taken of the effect upon stability of the ship by the use of water ballast to compensate for the reduction of these weights. The question is too complex to admit of a simple solution, but it may be safely assumed that there is sufficient stability in all cases to make the mean variation in water ballast of minor importance.

A comparison is shown between an existing Diesel ship and one having about the same weight of machinery, fuel and feed water.

Relative Expenditure Due to Capital Charges and Cost of Fuel.

Table III. gives estimates of these items for the different types of machinery in the same various types of ships and for various distances run per annum. The costs of machinery are for the whole installation of boilers, engine and auxiliaries, as completed in the ships.

Deduction from Table III.—In the case of 20-knot vessels, the Diesel type of engine costs £13,000 per year more to run than the steam, while at 17 knots the cost per annum of the Diesel is £7000 more than that for the steam. But the cost of running the steam vessel at 18 knots is only £8000 per year more than the Diesel at 17 knots. Some investigations have been made for higher powers, which may be of interest. In the case of the 20-knot vessel with the (*c*) type of machinery, it will be seen that a gain of 1052 tons of weight is available in the 3230-mile voyage. Transforming this weight into machinery fuel and make-up feed, it is possible to increase the shaft horse-power to 40,000 and the sea speed to 22 knots.

It is to be remarked that the weight of turbine machinery per shaft horse-power tends to decrease with increase of power. An estimate of an installation of such machinery for 55,000 horse-power in a 24-knot ship shows that the weight is about 3600 tons, which is one-third more than that in a 20-knot ship, while the power is more than double. It is not easy to see how a Diesel installation of this power could be applied to a ship at the present time, and its weight would probably be about 8000 tons.

It is, however, in the region of lower powers than those dealt with that the interest of the large majority of shipowners is most centred. It cannot be said that the turbine has displaced the reciprocating engine in this region. The

Table II.

Type.	(*a*) Diesel.	(*b*) Steam.	(*c*) H.P.T.	(*a*) Diesel.	(*b*) Steam.	(*c*) H.P.T.	(*a*) Diesel.	(*c*) H.P.T.	(*c*) H.P.T.
Sea speed, knots	20	20	20	20	20	20	17	17	18
Fuel per S.H.P.	0.5	1.0	0.7	0.5	1.0	0.7	0.5	0.7	0.7
S.H.P.	27,000	28,000	27,000	27,000	28,000	27,000	13,500	13,500	16,000
Distance in nautical miles	6,460	6,460	6,460	3,230	3,230	3,230	3,230	3,230	3,230
Weight of machinery	4,450	4,250	2,700	4,450	4,250	2,700	2,650	1,300	1,600
Weight of feed water	109	1,507	727	55	754	364	32	214	253
Weight of fuel	1,947	4,037	2,725	973	2,018	1,362	572	802	948
Weight of machinery, fuel and water	6,506	9,794	6,152	5,478	7,022	4,426	3,254	2,316	2,801
Weight of half fuel and water	1,028	2,772	1,726	514	1,386	863	302	508	600
Weight less half fuel and water	5,478	7,022	4,426	4,964	5,636	3,563	2,952	1,808	2,201
Gain over Diesel in weight of machinery, fuel and water	—	3,288 loss	354	—	1,544 loss	1,052	—	938	453
Gain over Diesel less half fuel and water	—	1,544 loss	1,052	—	672 loss	1,401	—	1,144	751

Table III.—*Annual Costs for Voyage of* 120,000 *Miles.*

	(*a*) Diesel.	(*b*) Steam.	(*c*) H.P.T.	(*a*) Diesel.	(*c*) H.P.T.	(*c*) H.P.T.
S.H.P.	27,000	28,000	27,000	13,500	13,500	16,000
Cost of machinery	£460,000	£380,000	£333,000	£240,000	£175,000	£210,000
Interest, depreciation, insurance and maintenance per year	£85,100	£70,390	£61,605	£44,400	£32,380	£38,850
Distance steamed per year, miles	120,000	120,000	120,000	80,000	80,000	80,000
Fuel burnt per year, tons	36,160	75,000	50,625	14,180	19,853	23,472
Cost of fuel per year	£144,640	£243,750	£164,531	£56,720	£64,522	£72,287
Lubricating oil per year, tons	337.35	7.03	6.78	132.3	2.66	3.14
Lubricating oil, cost, per year	£11,554	£241	£232	£4,531	£71	£108
Feed water for boilers per year, tons	2,025	28,000	13,500	794	5,294	6,259
Cost of feed water for boilers per year	£160	£2,217	£1,068	£63	£419	£495
Engine-room wages per year	£10,000	£12,000	£11,000	£6,600	£8,000	£9,000
Total running expenses	£160,354	£258,208	£176,831	£67,914	£73,012	£81,890
Charges	85,100	70,390	61,605	44,400	32,380	38,850
Total	£251,454	£328,598	£238,436	£112,314	£105,392	£120,740

Reserve Feed Water.—This item is considerable, and depends on the length of voyage and how much make-up feed is made by the evaporators.

Some authorities have determined the amount of make-up feed required in cylindrical boilers in merchant ships to be 3½ tons per 1000 horse-power per day. From observations in some recent passenger ships, this amount of reduction in weight of the (*c*) installation is due in part to the use of high efficiency water-tube boilers and oil fuel, which require higher skill in their handling than the ordinary merchant ship boiler, coal-fired. But a similar consideration has to be kept in view in the adoption of the Diesel engine in the ordinary type of tramp steamers. Both types of vessel involve the training of more highly

* Institution of Naval Architects, April 1st, 1925.—Abridged.

skilled engine-room staffs, which time only can create.

In the case of cross-Channel steamers of high speed, the turbine has completely displaced the reciprocating engine. In this case the weight and first cost of the installation are the dominating considerations, for the distances run are short and the amount of fuel carried is comparatively much smaller than in vessels trading overseas. It is of interest to examine such a case to see if steam is likely to be displaced by the Diesel engine. The case of an installation for a 20-knot vessel of 5200 horse-power has been chosen.

The following are comparative figures for a twin-screw vessel :—

Item.	(a) Diesel.	(b) Present turbine arrangement	(c) With H.P. turbine scheme.
Power	5,200 S.H.P.	5,200 S.H.P.	5,200 S.H.P.
Oil consumption, all purposes	1.15 tons per hour	2.09 tons per hour	1.67 tons per hour
Oil per S.H.P. per hour, all purposes	0.5 lb.	0.9 lb.	0.72 lb.
Weight of machinery ..	740 tons	570 tons	510 tons
R.P.M.	260	260	260
Cost	£100,000	£62,000	£65,000

The possibilities of steam in comparison with the Diesel can be seen from the foregoing tables.

The question of the practicability of producing reliable machinery of the (c) type is one for the the marine engineer. Two difficulties will suggest themselves to him—first, that of condenser tubes, and, secondly, that of steam joints. Some of the land engines of this type which have been successfully run have fresh water for circulation in the condenser, and a leak in the tube is of relatively small importance. The use of possibly leaky condenser tubes with water-tube boilers is not new in ships, and while bad results have been obtained, there is no sign of abandonment of either the condenser or the water-tube boiler, either in the Navy or the mercantile marine. The second obstacle, that of steam joints, presents no serious difficulties in the land installations, because these installations are usually in large open buildings in which steam leakage of high-pressure high-temperature steam produces no serious results, such as might be the case in a ship. If, however, we look back on the development of the present steam pressures, we cannot but be encouraged by the belief that the same skill in the marine engineer which has produced the present steam joints is quite capable of overcoming any further difficulties which may occur.

Sir Charles Parsons's proposals are made by a serious engineer, who is ready to carry them out. Other firms have been consulted, who in this respect are free from the suspicion of desiring favour for their own progeny, and they are quite ready to guarantee results equal to those promised by Sir Charles Parsons, so that there is solid foundation for belief in the statement of steam efficiency upon which the comparison with the Diesel engines is based. Further, one firm has offered equally favourable results in thermal efficiency, first cost, and weight of installation at a pressure of 265 lb., with an installation in which the greater efficiency in the method of producing the steam is expected to make up for the loss of efficiency due to the use of the steam of lower pressure. In this installation coal can be used.

Messrs. Yarrow and Co. have built boilers of 400 lb. pressure and 700 deg. of superheat for use in electrical power stations, and they have designed a Yarrow boiler of 500 lb. pressure and about 700 deg. of superheat for marine engines—Fig. 1.

Messrs. James Howden and Co. have proposed and are building a boiler of the cylindrical and water-tube type combined, which will have 315 lb. pressure and 700 deg. temperature, and with which they expect to get very high efficiency. In Fig. 2 the damper A controls the flow of gases through the superheater. That part of the gases which does not pass through the superheater reaches the uptake by the passages marked B. The feed water is introduced in the top back drum at C, whence it passes down the back rows of tubes to the lower drum, where it joins the water coming through the lower pipe from the cylindrical portion of the boiler, and passes upwards through the front rows of tubes to the top drum again, from which it enters the cylindrical portion of the boiler at boiler temperature. Both these boilers can be arranged to use oil or coal as fuel.

There are others working along the same lines, so that the proposals for the use of high pressure and temperature steam are receiving great consideration by several responsible firms.

More may be said on this subject, such as the possibility of the use of coal instead of oil in an emergency, the widespread knowledge of the turbine and boiler installations, the lower centre of gravity of the turbine installation, and the gain in deadweight carrying and its possible increased commercial efficiency; but perhaps enough has been said to draw out the views of others who have given attention to the subject, and to lead to the conclusion that the rumour that the steam engine is dead lacks confirmation.

In the oversea high-speed vessels, the weight is only in favour of the Diesel for a length of voyage considerably above 6000 miles, and even in such cases the mean displacement on the voyage may be 3 per cent. or more in favour of the steam vessel. For voyages of 3000 miles, there is a gain of over 1000 tons in weight to be carried, and a gain of 5 per cent. in the mean displacement on voyage in the steam vessel. In cross-Channel vessels the weight and cost make the Diesel prohibitive compared with the turbine. In all these cases the steam is superior to the Diesel in commercial efficiency.

Two appendices are given with this paper. In the first a method of calculating the steam consumption of a high-pressure geared turbine installation is given, while in the second particulars are furnished of the various types of Diesel machinery. Referring to the costs per brake horse-power of oil engine machinery, it is noted that prices varied from £31 in 1921 to £21 10s. in 1924 for Beardmore-Tosi oil engines, while for the Burmeister-Wain type of engines prices ranging from £18 to £31 6s. per brake horse-power are given.

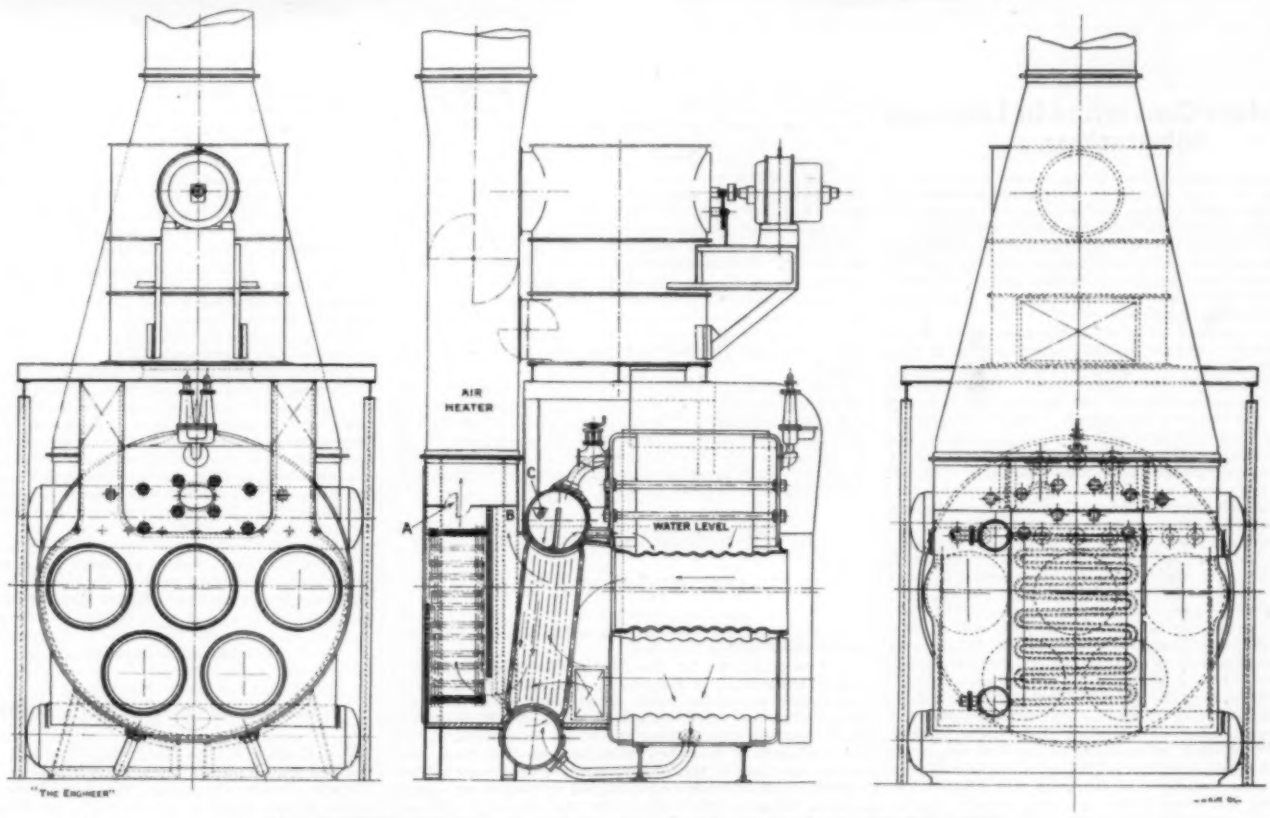


FIG. 2—HOWDEN COMBINED CYLINDRICAL AND WATER-TUBE HIGH-PRESSURE BOILER

Lathe Tools Research.

ON Friday, March 27th, Mr. Dempster Smith, M.Sc. Tech., M. I. Mech. E., read the second report of the Lathe Tool Research Committee, at a meeting of the Manchester Association of Engineers. The report deals with the behaviour of lathe tools when cutting cast iron, whereas the first report, published two years ago, dealt with the cutting of mild steel. In his introductory remarks, Mr. Smith referred to the criticism which appeared in THE ENGINEER when the first report was published. In the article referred to, the divergence in procedure and conclusions arrived at by different experimenters in that field of research were mentioned, and it was suggested that the experiments should be reconciled. The difference in the measure of durability selected by the various experimenters was also emphasised. Another point raised was the character of the variation in the cutting speed with the duration of the trial.

It will be remembered that in the previous report the Committee adopted the empirical law $V T^{\frac{1}{8}}$ equal to a constant, and drew attention to the fact that while F. W. Taylor obtained an identical expression, Professor Ripper found $V T^{\frac{1}{3}}$ equal to a constant. In the experiments of Professor Ripper the greatest duration of trial was 45 minutes, and in a few cases 60 minutes, whereas the trials of the Committee were extended up to 100 minutes, and the difference is attributed to the wider range of the inquiry by the Committee. The Committee sought ultimately to reduce its observations for single-cutting edge tools to a two hours' cutting life, which was considered to give the most economical conditions. The form of the expression was, Mr. Smith said, of no importance, since it was possible to discover what the cutting speed should be for a given time from the speed-duration curve, knowing the time the tool lasted when cutting at a certain speed.

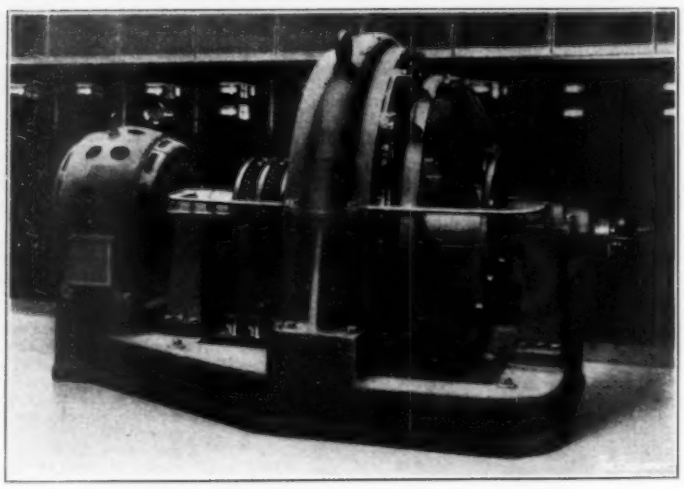
This report on the behaviour of lathe tools when cutting cast iron covers similar ground to the first report, which dealt with lathe tools when cutting mild steel. The behaviour of cast iron during the process of cutting is distinctly different from that of a ductile material such as steel. The latter leaves the stock as single uniform chips or in the form of a shaving with the chips adhering to one another, or like a ribbon. In cutting steel the heel of the shaving bears on the tool face at some distance back from the cutting edge, the cutting is torn from the stock, and a rent runs in advance of the cutting edge, thereby leaving it to trim up the ragged peaks on the bar and relieving it of the duty of continuously penetrating fresh stock. Failure in this case is brought about by the combined effect of the pressure and the velocity of sliding of the shaving which wears a groove on the top face of the tool, and this groove deepens and extends as cutting proceeds, until it reaches the cutting edge, which becomes too frail to remove the ragged peaks, and consequently breaks down. Because of the shortness or lack of ductility of cast iron the tool is constantly entering fresh stock, thereby dulling the cutting edge, and bringing about failure. The nature of the shaving and the character of the tool failure is different in the two cases, and data as to the cutting speed for different dimensions of cut and shape of tool when operating on mild steel afford little guidance as to what the speed should be when cutting cast iron.

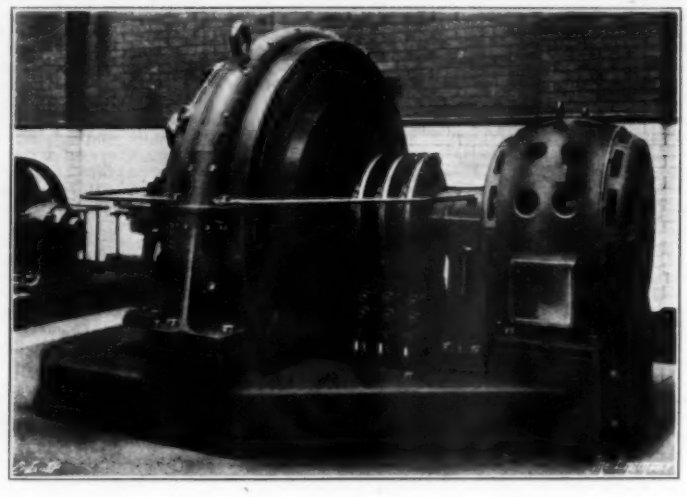
In the second report the Committee deals with the variation in durability of the tools with changes in the cutting speed; the change in duration with the changes in cross section of the tool; the variation in the cutting speed with the ratio of depth of cut to the traverse; the variation in cutting speed with the nose radius of the tool; and the variation in the cutting speed with the cutting angle when cutting with and without a cooling medium.

The cooling medium experiments gave some rather remarkable results. These trials were made with a 60 deg. plan angle tool having an $\frac{1}{16}$in. nose radius, on two cuts, viz., $\frac{15}{128}$in. by $\frac{1}{10}$in., and $\frac{1}{2}$in. by $\frac{1}{8}$in. The cooling medium consisted of one part of soda dissolved in fifty parts of water. The solution was directed vertically downwards on to the nose of the tool and shaving at the rate of about $1\frac{1}{2}$ gallons per minute. Both series of experiments show a distinct gain due to the use of the cooling medium. In the case of the $\frac{1}{2}$in. cut the average gain is about 13 per cent.; varying from 8 per cent. with the 90 deg. cutting angle tool to about 20 per cent. with the 60 deg. cutting angle tool.

1500-KILOWATT SELF-SYNCHRONISING ROTARY CONVERTERS

MATHER AND PLATT, LIMITED, MANCHESTER, ENGINEERS





New Rotary Converters in Liverpool Sub-stations.

THE growing traction and lighting load upon certain sub-stations of the Liverpool Corporation electricity department's supply system, necessitated the installation last year of much new plant to cope with the demand. It was resolved early in 1924 to install additional converting plant at sub-stations scattered in various parts of the city, and a contract was placed for twelve rotary converter equipments of 15,000 and 1000 kilowatts with Mather and Platt, Limited, Manchester.

The new machines in certain cases replaced motor generator sets of smaller capacity which had seen long service. The Liverpool supply system is alternating-current, 6000 volts, 50 cycle, three phase. The converters are arranged to operate at 460/480 volts or 525/545 volts on lighting and traction respectively. These voltages are obtained by means of tappings on the high-tension side of the transformers, the tappings being controlled by an oil-immersed interlocked throw-over "Selector" switch. The rotary converters are of Mather and Platt's standard type, incorporating several interesting features of design. The direct-current brush gear is exceptionally rigid and simple, with a minimum inertia of the moving parts and a maximum clearance between brush arms. These features are obtained by the use of helical springs acting directly on, but fully insulated from, the brushes, so that it is impossible for the springs to carry any current. As there are no other moving parts whatever, it is possible to use a brush of adequate length without undue increase of inertia. A substantial metal shield is fitted to each brush arm, as can be seen from the illustrations given above, completely protecting the springs and brush flexible from damage. In order to give easy access to the brushes, this shield is hinged. The slip rings are of a bronze mixture of carefully controlled composition, to give long wear. As far as possible, the main principles of the direct-current brush gear have been applied to the slip-ring gear. The arms carrying the brush boxes are exceptionally sturdy, and the whole gear is insulated with mica, and supported in such a way as to permit of a convenient arrangement of terminals for the low-tension alternating-current cables.

All twelve rotaries are equipped with the Mather and Platt's patent starting and self-synchronising gear, of which the Liverpool electricity department had had experience on smaller machines—three of 500 kilowatts—installed during the previous year. It is claimed that this system represents an important advance upon any method hitherto employed for starting and synchronising rotary converters. In this system, the stator of the pony motor has a single winding, devoid of complications, and has the same number of poles as the converter. The rotor is a plain indestructible cylinder of iron or steel, mounted on an extension of the main armature shaft, so that no additional bearings are required. This rotor possesses a very high starting torque, which quickly brings the converter nearly up to speed. At this point simple and effective patented means are provided for reducing the slip to a very low value, while the same operation simultaneously increases very considerably the synchronising torque exerted by the converter. The latter is thus enabled to pull itself quietly and quickly into step without hunting or surging, and remains quietly in step until normal voltage is built up, when the pony motor can be cut out of circuit. In the event of a reversal of polarity occurring when synchronising, or from any other cause, the polarity can be corrected at once without throwing the converter out of step, and without delaying operations except for the few seconds required to operate the field switch. An ordinary moving coil voltmeter with a set-up zero gives all the necessary indications of synchronism, polarity and voltage, and no other synchronising instruments of any kind are required.

The system is therefore unique in combining the advantages that the pony motor has a simple stator winding, and an indestructible rotor with high starting torque characteristics, requiring no additional bearings. No auxiliary resistances or choke coils are required, and the starting current is quite low—normally about one-third of full-load current. The switching and synchronising operations are of the simplest nature, so that a relatively unskilled operator can start up a converter of any size from rest, synchronise with ease and certainty, and have the machine ready to put into service in about thirty to forty seconds.

The pony motor is very liberally rated, and is capable of several starts in succession without injurious heating. As the operation is invariably successful first time, however, this feature only becomes of importance in the event of repeated failures of the supply to the machine. In this contingency the operation of synchronising is just as easy and certain on the subsequent occasions as on the first. Since the pony motor has the same number of poles as the converter, the normal synchronous speed of the latter can never be exceeded during the starting and synchronising period. The overspeed device can therefore be set to operate as closely as desired to the normal speed. For the same reason, the pony motor can be employed to drive the converter at normal speed if required for grinding the commutator or slip rings. Under these conditions, the losses are quite low and the motor does not become overheated.

It is worthy of note that the standard rotary converter equipped with the Mather & Platt patented starting and self-synchronising system is immediately adapted for automatic or remote control without alteration of the mechanical or electrical features and without the sacrifice of the adequate brush shielding and very rigid brush gear which has been described above.

A One-day Exhibition.

AN engineering exhibition of a rather unusual character was recently held at Dartford.

It was organised by the North Kent Section of the Junior Institution of Engineers, and was noteworthy in that it was for one day only. That is to say on Saturday, March 21st, for which date Messrs. J. and E. Hall had kindly lent the works dining hall to the Institution. In the circumstances it was very refreshing to find that even before the time of the official opening ceremony all the exhibits were in place and attended by people who could explain their merits. Naturally the majority did not come from very far afield, for the district has several engineering firms of well-known standing, which provided some interesting material; but several of the stands were occupied by companies only indirectly associated with North Kent.

The hall was set out with a series of long tables so arranged that the visitors might comfortably pass from one exhibit to another. Apart from the essentially utilitarian exhibits, a number of amateur models, much after the fashion of the Model Engineer Exhibition, were on view. The models at Dartford were, however, distinctive, as the majority of them had been built up out of scrap material. It is, however, a mystery to us how a four-armed fly-wheel, about 10in. in diameter, palpably cast, could be called scrap, whilst the genesis of a compound engine cylinder assembly is still more difficult to account for. Anyhow, we do not propose to make extended reference to the models, as several have already been described in our columns.

Among the more serious exhibits those of J. and E. Hall naturally took a prominent position, and included the little refrigerating machine which was exhibited last year at Wembley, a variety of tools designed for special purposes, such as milling cutters, trepanning tools, &c., and a "cut-through" section of a 30 horse-power Hallford petrol engine and its transmission gear. But one of the most interesting of Messrs. Hall's exhibits was a drilling machine. This machine is used for drilling very fine holes in atomisers, each of which has some 250 holes. Originally, when the design of atomiser was brought out in America, it took a boy a day to drill two pieces; but with the Hall machine, which works on six atomisers simultaneously, 1530 holes, 0.042in. in diameter, can be drilled in 15 minutes.

Fraser and Chalmers had a stand near the entrance, on which there were shown examples of turbine blading with the shrouding riveted in place after electrical heating, a very fine example of impeller for a centrifugal air compressor, and some specimens of rubber conveyor belting.

Vickers, naturally, were represented, principally by an aero engine and some samples of ply-wood. One of these samples comprised not only thicknesses of ply-wood, but also an intervening 4in. layer of cork, for insulating purposes, and outside sheathings of metal. The same company also showed a number of drop forgings in various stages of progress.

The Howard Pneumatic Company had in operation the Hallet machine for tightening plates prior to riveting, which we described in our issue of December 12th, 1924.

Aveling and Porter showed one of the little radial steam engines used in the steering gear for their road rollers. Hancock and Co., of Aurelia-road, Croydon, had an oxygen cutting blowpipe of much the same style as that described in connection with the British Industries Fair in THE ENGINEER of February 27th, last; Walker and Crossweller exhibited a large range of boiler-house instruments. The Michell Bearing Company had a model of its well-known marine thrust block, Johnson and Phillips displayed some switchgear, the Western Electric Company had a large stand covered with all kinds of what might be called domestic electrical appliances, and Elliott Brothers had a variety of electrical testing instruments.

The exhibition was opened by Mr. A. J. Ward, chairman of Messrs. J. and E. Hall, who urged the necessity for encouraging the younger generation of engineers to progress in their profession and to persevere in hard work. Incidentally he mentioned that quite recently he had noticed that the engineering business of Trieste was much more prosperous than that of Genoa, and suggested that the reason was the technical training acquired from the Germans, which the former district obtained, but which did not spread to Genoa.

In view of the fact that the exhibition was held on a Saturday afternoon, and at a time of the year when most young men are fretting to be outdoors, it was very gratifying to see what a good attendance there was in the hall.

ROYAL MICROSCOPICAL SOCIETY.

THE Council of the Royal Microscopical Society has received an invitation from the University of Sheffield, through the Vice-Chancellor, Sir Henry Hadow, to hold a Conference at Sheffield on Monday, the 20th, inst., and following days. This invitation, which was supported by invitations from the Lord Mayor—Alderman A. J. Bailey—the Master Cutler—Mr. W. W. Wood—and others, has been unanimously accepted. The meetings of the Conference will be held at the University on the mornings of the Tuesday and Wednesday, and at those meetings a series of papers will be read and discussed. Among the papers promised are the following:—Mr. J. W. Barnard, F.R.S., "Modern Microscopical Methods"; Mr. Conrad Beck, "Resolution and Illumination with the Microscope"; Sir Kenneth Weldon Goadby, "A Note on Lung Fibrosis in Iron Mining;" Sir Robert A. Hadfield, Bart., F.R.S., Mr. T. Gifford Elliot and Mr. George B. Willey, "The Development and Use of Microscopic Methods of Investigation in Steel Works"; Mr. F. F. Lucas (Western Electric Company, New York), "Some Recent Developments in Metallurgical Research: New Facts Developed by High-power Metallography"; Mr. F. I. G. Rawlins, "Microscopy and the Modern Physics"; Mr. W. J. Rees, "The Microscopical Examination of Refractory Materials"; Dr. F. Rogers, D. Eng., B.A., M.Sc., M.I.M.E., "Test Objects for Metallurgical Microscopy"; Mr. J. F. Strachan, F. Inst. P., F.R.M.S., "The Microscopical Structure of Paper-making fibres in relationship to their Manufacturing Properties"; and Mr. Harold Wrighton, B. Met., F.R.M.S., "Some Details in Metallurgical Microscopy."

The Lord Mayor will hold a reception at the Town Hall on the Monday from 4.30 to 6 p.m. The Vice-Chancellor of the University has invited visitors to the Conference to a reception at the Firth Hall of the University, Western Bank, on Monday evening from 8 to 10 p.m., and the Master Cutler has invited the visitors to the Conference to a reception at the Cutlers' Hall on Tuesday evening from 8 to 10 p.m. The ordinary meeting of the Society for April will be held at the University, Western Bank, during the Conference. A trade exhibition of the latest scientific instruments and apparatus will be open at the University, Western Bank, throughout the Conference. Visits to works will be made during the afternoons of Tuesday and Wednesday at the invitation of the following firms:—Cammell Laird and Co., Ld.; Thos. Firth and Sons, Ld., including the Brown-Firth Research Laboratories; Hadfields, Ld.; Jos. Rodgers and Sons, Ld.; Vickers Ld.; and Walker and Hall, Ld.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Trade Situation.

There is very little expansion in demand for iron and steel in the Midlands area, and the outlook is not encouraging. The heavy engineering industry with the exception of the constructional branch, is poorly off for work, and inquiries are anything but numerous. Motor engineering is, however, in a flourishing condition and is calling for large quantities of black sheets, &c. Midland electrical trades are, on the whole, very busy, and firms which execute special foundry work for this line of business are hard put to accommodate the demands made upon them.

Finished Iron.

Improvement has not yet developed in the Staffordshire finished iron trade, and a large proportion of plant is being used for the re-rolling of steel chiefly of of foreign origin. Re-rollers do not appear to be maintaining their position, however. Some good orders for ironfoundry are reported to be pending, and it is hoped this district will participate in them, but for the present there is only hand-to-mouth buying of raw material. Marked bars continue in fair demand at £15, but the mills could easily handle much more business. Crown bars are very slow of sale, consumers being unprepared to pay anything like the £12 15s. demanded by local makers. An increased number of orders have been placed lately for nut and bolt iron, and there are signs of greater activity in this department, although with the present disparity in prices the local mills have a poor outlook. With Belgian No. 3 iron available at £7 10s., it is, too generally, preferred to Staffordshire nut and bolt iron at £11 15s., although the quality of the former is admittedly poor. The nut and bolt trade is rather busier, the numerous bridges placed in recent months calling for a fair quantity of this material. Wrought iron gas tube strip continues in fairly good request, and values are maintained at from £13 to £13 2s. 6d.

Galvanised Sheet Values.

Galvanised sheet prices, after the recent heavy slump, have now risen sharply, many Midland mills demanding 7s. 6d. per ton more than they were prepared to accept a week or so ago. On 'Change in Birmingham today—Thursday—£16 7s. 6d. to £16 10s. was a fairly general basis for 24-gauge corrugateds. The low quotations of recent weeks have disappeared, but some business was stated to have been booked at slightly below £16 7s. 6d. On the other hand, a few special export orders have been taken at prices better than £16 10s. The readjustment of values was not inspired by any expansion of demand. It was intended apparently as a protest against the price cutting which has latterly disintegrated the market.

Steel.

Demand for constructional steel gives little ground for complaint, and is almost wholly responsible for the work in operation. Steel mills, however, are not doing more than half time. Fresh work comes out in a rather encouraging way for bridges, including a few lines for India, though this district is not well placed for export construction owing to the additional burden of railway rates and somewhat higher steel prices than are quoted on the coast. The market is so over-supplied with steel that prices are weakening in almost every direction. Quotations for structural steel have long ceased to have any real relation to the prices declared by the Association. Engineers claim to be able to get concessions below the £8 15s. figure for joists and sections. These figures are severely cut by Belgian quotations. Considerable tonnages of joists are coming into the district at £6 14s. 6d. delivered, giving an advantage of £2 per ton. British makers say that these figures cannot be met in competition until cheaper coal is possible, and the heavy burdens of taxation are substantially reduced. The Belgian and French works are reported to be fairly well booked, and it is understood that deliveries of new orders cannot be looked for before May. In some cases June and July are named. But the Belgian prices do not show a corresponding improvement, Belgian billets being quoted at £6 5s. to £6 7s. 6d. delivered, as against the English figure of £7. Steel bars are quoted as low as £5 15s. f.o.b. Antwerp, and are making most effective competition in the principal export markets. Native bars command about £8 15s. to £9. English wire rods have been reduced 10s. to £10 10s., No. 4 rods rolled from continental billets are £9 10s.

Raw Iron.

The action of Cleveland smelters in advancing pig iron quotations by 6d. per ton was welcomed in this district as indicating a determination to arrest the downward movement. Midland irons have been firmer than Cleveland for some time, but advances seem to be out of the question at present. Northamptonshire and Derbyshire furnacemen are glad to pick up what business they can at the prices which have ruled during the last few weeks, and consumers show no more disposition to buy ahead. Users of pig iron have been buying purely for urgent needs for some time now, and it is considered the advent of firm prices would have a marked effect on demand, while any price advance would bring into the market quite a lot of business which is now being held up. Many consumers even now, however, are not convinced that bottom has been reached. Furnace coke is sufficiently plentiful to give the furnacemen an advantage, and although values are lower, further reductions are looked for. On 'Change in Birmingham today Northamptonshire foundry iron was quoted £3 12s. 6d. to £3 14s., and forge £3 8s. to £3 9s. Derbyshire No. 3 foundry commanded £3 17s. 6d. to £3 19s., and forge £3 13s. There is practically no demand for forge sorts.

Coventry Gasworks Extension.

The Coventry City Council has been recommended by its Gas Committee to approve of the second section of the scheme of extension at the Corporation Gasworks at Foleshill being proceeded with, at an estimated cost of £266,310. The total scheme, which involves an estimated cost of £425,000, was originally approved in 1919, when it was decided to carry out the work of extending the plant at the gasworks in two sections. The work which it is now proposed to proceed with includes the installation of vertical retorts of 2½ million cubic feet capacity per diem, &c., at a cost of £96,000, and a 5 million cubic feet capacity gas-holder and tank, at a cost of £90,000. In addition, it is proposed to extend the railway sidings at the works at an estimated cost of £18,500.

Wagon Works Dispute.

A settlement has fortunately been reached in the strike of vehicle builders employed by the Gloucester Railway Carriage and Wagon Company, Ld., reported in our issue of March 20th, and the 100 men concerned resumed work on Monday last. The strike commenced on March 11th, when 100 members of the National Union of Vehicle Builders ceased work on account of a dispute as to whether the Gloucester rates of wages, which they were receiving, should be superseded by the Birmingham rate. The question was stated to be an involved one.

Science in Industry.

The Industrial Laboratory, which is part of the municipal equipment of Birmingham, is giving valuable service to the advancement of manufacturing efficiency. It is a development due to the initiative of the gas department. Its sphere of utility is, however, wider than the studying of problems of the application of gas to industry. The laboratory at the Council house is equipped for the testing not only of metals, but of concrete, cements and brickwork. The installation includes a 100-ton machine for tensile and compression tests, which is capable of dealing with iron or steel bars up to 2in. diameter. Admiralty contractors, who formerly had to send their products to London or Sheffield to be tested, can have the work carried out at the Birmingham laboratory under the inspector's eye. A good many ironmasters make use of the facilities in connection with ordinary commercial work. It is more than doubtful, however, if the advantages which the iron trade stands to gain by an extension of the work are fully appreciated.

Workless.

The number of workless in the Midlands continues to decrease, the latest returns showing the registered unemployed to number 129,842, as against 130,830 a week ago. Of the total 93,037 are men, 1352 boys, 32,965 women, and 2488 girls. Slight increases are recorded at Bilston, Coventry, Cradley Heath, Oldbury, Smethwick, Stoke-on-Trent, Stourbridge, and Brierley Hill, and at West Bromwich. The absorption into industry in other Midland districts, however, has been more than sufficient to cover these increases.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Outlook.

The markets here, both for ferrous and non-ferous metals are weaker again, and more depressed. It is now obvious that no improvement can take place before Easter, and if it should happen that the period between Easter and Whitsuntide should pass without any movement, then we may abandon hope until the late autumn; but the puzzle just now is to discover any possible chance of a revival in the state of trade; one does not see whence it is to come, even if the financial situation becomes more favourable. In this district the opinion is growing that no recovery can be made under existing conditions of the cost of production. Rates, taxes, wages and fuel, people say, must all be brought down to a reasonable level, if business in Lancashire is to recover, and although everyone is agreed as to this necessity of general economy, no one can say definitely how it is to be brought about.

Metals.

It is becoming increasingly evident that the present output of copper in America is too great for the needs of trade, and unless the copper producers are willing to submit to a self-denying ordinance and to work together for a restriction of output, prices are likely to keep low. As we write, standard copper looks like going back to £60 per ton in London. It is nearly nine months since standard copper was as low as it is now, and the fact that it can return to bottom prices again has taken all heart out of the market, and brought about a fear that anything may be possible. Consumers in this district are keeping off the market; but it is not so much the fear of lower prices which causes them to do so as the general condition of the engineering trades. There is little inducement to hold stocks of copper simply because of low prices, when it is uncertain whether engineering is ever going to recover in this district. Engineering, like the coal trade, seems now unable to pay a living wage to its workers, and this position is almost bound to lead to trouble. There is a belief here that the recent weakness in copper is not unconnected with Wall-street operations, and that possibly preparations are being made there to engineer another sharp advance. On this point people ought to be cautious, for with standard copper at £60 there would certainly be room for another "bull" speculation. The official price of sheets has been reduced to £90 per ton, and ¼d. per lb. has been taken off the tube prices. The position in the tin market remains rather unsettled, and merchants here do not seem to be able to take any decided view as to the future. There are those who still prophesy higher prices for tin, and, of course, it must not be forgotten that there is no longer any substantial reserve stock of tin in the East; but it is by no means clear that the disposal of the remainder of the stock has not left merchants and consumers with rather too much metal on hand. Both lead and spelter have been inclined towards weakness, but the former is probably in a more dangerous condition than the latter. Since the beginning of this year, the price of soft foreign pig lead has fallen by just £8 per ton, whereas during the same period spelter has fallen £2 10s. per ton and copper £5 10s. per ton.

Pig Iron.

There is scarcely any doubt that the markets for pig iron are again getting weaker as a consequence of the very inadequate demand; but the prices move downwards only very slowly, and it is difficult to see much difference from week to week. There is no margin now for reductions, for although furnace coke is perhaps slightly easier here and there, the fall is trifling, and other expenses are much as they were. The markets, however, have no stamina, and makers are very nervous about accumulations at the furnaces. In the Manchester market buyers seem to be very shy and one hears of nothing but small retail orders, and these are placed at the lowest prices. The usual quotation for Derbyshire No. 3 foundry iron is now based on 77s. 6d. at the furnaces, equal to from 85s. to 85s. 6d. per ton delivered in this district; but consumers are evidently not satisfied that the market is yet at the bottom. The furnace price of Northamptonshire iron is only 72s. 6d. per ton, and although with the present rate of carriage this iron is about as dear as Derbyshire, when delivered in Manchester, it is urged that if Northampton makers can produce foundry iron at 72s. 6d. at the furnaces, then both Derbyshire and Cleveland ought to be able to sell at less than 77s. 6d. The main point to be remembered, however, is not the cost of producing iron, but the fact that, low as the output is, it is still in excess of the demand. A continuance of this state of things is bound in the end to tell upon the market price; and at present there is no sign that the demand in this country is likely to improve. Scotch iron is still quoted here at 103s. 6d. per ton delivered, but there is no demand for it, and East Coast hematite iron is easy at about 96s.

Finished Material.

There is very little change on the surface in the markets for manufactured iron and steel, but the enormous difference in price between British and foreign material is having a very deleterious influence on trade. The consumption of Lancashire iron is slowly dying, and one cannot be surprised while the price is rigidly maintained at £12 10s. per ton. For the heavy branches of the steel trade there is no sign of relief at present. A small inquiry exists here, and sellers do not make any open reduction in the prices. Indeed, it is said that makers of steel plates have reached some sort of informal agreement not to sell in this district under £9 15s. delivered. Joists and angles are nominally at £8 15s., but one does not hear that there is any agreement, formal or informal, about this figure. Probably £8 10s. would be accepted gladly for a good order.

Scrap.

There is little to be said about the scrap market. Dealers are very depressed, and are not at all inclined to buy unless with a big margin of profit on present nominal selling prices. Hence they are offering only 60s. for melting steel scrap. The ironworks buy a little heavy wrought scrap at 80s. delivered, or perhaps 85s. per ton for special lots. In the market for cast scrap prices are rather irregular. Strong holders of textile machinery scrap are standing out for 87s. 6d. per ton on the plea that this class of metal is scarce, and when wanted by a founder is cheap at that figure. Ordinary broken machinery metal is more variable, but as a rule from 80s. to 82s. 6d. per ton is quoted by dealers. There are, however, reports of sales at lower prices, and some ironfounders will not offer more than 75s. per ton.

Manchester Association of Engineers.

The annual report of the Council of the Manchester Association of Engineers indicates that the number of members at the close of the year 1924 was 803, or 41 less than in the preceding year. The students' section comprised 216 members, but it would appear that this section is not making the progress that was expected by its founders a few years ago. The report states that in spite of an active Committee and a good syllabus, the numbers of student members that have attended the various meetings were not as large as they ought to have been, and a special committee has been formed by the Council to ascertain the best steps to improve matters. The financial statement relative to the year's operations of the Association shows that the expenses have exceeded the receipts by £498, but part of this amount is accounted for by the removal of the secretary's office to premises adjoining the Engineers' Club. The funds of the Association invested in trustee stocks amount to about £7000. At the annual meeting held on Friday, the 27th ult., Mr. R. Onions was unanimously elected President for the ensuing year. Mr. Onions is associated with Ruston and Hornsby, Ld. He is an old member of the society, and has played an active part on the Council for many years. Messrs. Bentham, Boswell, J. Butterworth, S. H. Heywood and Dempster Smith have been elected to the Council.

BARROW-IN-FURNESS.

Hematite.

The hematite pig iron trade remains dull, but the output of thirteen furnaces is being maintained, owing to the fact that the Barrow and Workington rail mills are still working. Customers in this county are ordering bare requirements, and have not been tempted to buy more freely as a result of the recent reduction. The number of home inquiries is not considerable, and there is a general tendency to postpone placing orders for mixed Bessemer numbers for forward delivery. The foreign trade is very unreliable. A certain amount of business is being done, but there are no real grounds for expecting a rush or anything like a rush. The trade with America continues, but

it is most difficult to say how soon the bottom may drop out of it. There were part cargo shipments of pig iron to Kobe, Calcutta and Philadelphia from Barrow last week. Japan occasionally takes pig iron in connection with work at the naval yard at Kobe. The continental trade is not worth talking about at present.

Steel.

The steel trade remains quiet with a shortage of large orders to keep the mills going for a good period. Barrow and Workington hold orders which will keep the former going regularly for a few weeks and the latter on alternate weeks. The merchant mill has started again at Barrow, and will run for a week or two. The Siemens department and the foundry are still at work, and the hoop and small section mills have orders to keep them going for some time, but as the output is rapid at the two latter mills, fresh orders are always required.

Shipbuilding and Engineering.

The disappointment felt in Barrow when the news arrived that Vickers had not obtained a share in the Australian cruiser orders was very keen indeed. We were quite confident in this town that one vessel would be built here, and there is much speculation as to the reason for the order for both going elsewhere. The price was very keen indeed. There is some comfort in the order for two submarines at a price of about £750,000, but it was a cruiser that was wanted. Barrow now awaits news of the naval programme of this country, and hopes to share in it.

SHEFFIELD.

(From our own Correspondent.)

The Basic Steel Slump.

THE quarter has closed without any relief to the depression which has brooded over the pig iron and semi-manufactured steel departments throughout most of the period. A straw, which it is hoped may show that the wind has changed, is the fact that some inquiries for supplies during the next few months are reported, but the scarcity of orders is as pronounced as ever. There is no forward buying of basic billets, and the demand has shrunk to such small proportions that the working furnaces of the district, comparatively few though they are, are mainly producing acid steel. Exceptional cases, in which a fair amount of activity is maintained, are the works of the Parkgate Company, Brown Bayley's, and Industrial Steels. At Stockbridge, the melting plant of Samuel Fox and Co. is only operating at half capacity. Out of the fourteen large furnaces at the Templeborough works, only five are working, while, Cammell Laird and Co., at their Penistone works, have been operating one basic and two acid furnaces out of a total of six. The limited call for basic billets cannot be attributed to foreign competition, as comparatively little cheap continental material is coming into the district. The rolling mills are not well employed; in fact, as a rule, they are working only a short week, and, in view of the small volume of business coming forward at present, the future is regarded as very uncertain. There was a considerable falling off, during March, of the exports of the cheaper rolled steel.

The Australian Cruisers.

Much satisfaction is expressed in the city at the report that the two cruisers for the Australian Government are to be built by a Sheffield firm, John Brown and Co., Ld. No official confirmation of the report has been made locally, but the first cablegram which came from Melbourne last week was followed by another stating the news was officially confirmed. The value of the order is given as approximately £4,250,000. At the same time, Messrs. Vickers are reported to have been successful in securing contracts for two submarines, at the price of £716,340. Messrs. Brown will, if the report be confirmed, of course build the cruisers at their Clydebank yard, but the order will bring a valuable amount of work to their Sheffield armour plate, heavy forging and other departments.

Armour Plant Maintenance.

The armour plate plants of the city have been very poorly employed for a considerable time—ever since the effects of the Washington agreement began to be felt, in fact—and the question of their maintenance, which has been raised on several occasions, has been brought forward again by Mr. W. L. Hichens, the chairman of Cammell Laird and Co., Ld. There are five of these plants in the country altogether, three of them being in Sheffield. They represent a large amount of capital—probably about half a million sterling each—which for some years has been earning a very poor return. It is in the interests of the country that they should be kept up, for if they were scrapped they could not be replaced within a short time nor under about twice their original cost. "If it can be said with certainty that the day of armaments has gone never to return," said Mr. Hichens, "it would be wise policy to scrap the existing armour-plate plants. But if the future is uncertain, if there is a possibility that some day these plants may be urgently wanted—and this is surely the most reasonable assumption—then the Government must make some provision for maintaining them in being. This is not merely elementary justice; it is common sense, for unless something is done no firm will continue to maintain a costly armour plant."

The Lighter Steel Trades.

A state of quietude prevails in the crucible steel trade. As far as high-speed tool steel is concerned, the home consumption shows up rather better than was the case last year at this time, particularly in motor and general engineering, but the export demand is flat. The material is expensive, and France, Belgium, and Italy are unable to make large purchases owing to the depreciated state of their currencies. They are having recourse to German or home-manufactured steel, which is much cheaper than that of Sheffield, but lacks the durability of the latter. There has been a falling off since the early part of the year in the demand for plain carbon steel, and the quantities being exported are very small. The builders of heavy motor vehicles appear to be busy, and are sending in good orders for springs and various steel materials. Business is much quieter in cold-rolled steel strips, and a good deal of short time is being worked by the rollers of wire rods, consequent on the reduced activity of the wire trade.

An Old Works Closed.

Thos. W. Ward, Ld., of Sheffield, have purchased the works and goodwill of the business of George Cooper and Sons, Ld., nut, bolt and rivet manufacturers, Effingham-road, Sheffield. The business was established about 1869, and the firm had a wide connection. The closing of the works is an evidence of the serious depressions in the iron and steel manufacturing industries. It is expected that Messrs. Ward will find some means of carrying on the business, and preventing further additions to the ranks of the unemployed. Further particulars will be available later.

Cutlery and Plate.

Unsatisfactory conditions prevail in the cutlery and plate trades, and the only firms which are able to obtain a considerable amount of work are those having connections with the Dominions. Large quantities of cheap stainless knives are being sold, chiefly by small makers, and there are some big contracts about, but even this department is not as busy as it was last year. There is a falling off in the demand for the better quality stainless knives, pen and pocket knives, scissors and razors. On the electro-plate side, the trade in spoons and forks, though still large, is not maintained at its recent high level; but, on the other hand, the sterling silver trade is doing rather better in hollow-ware and spoons. The Britannia metal trade is in a depressed state.

New Bridge Over the Trent.

The Unopposed Bills Committee of the House of Commons has passed for third reading the Bill promoted by the Nottinghamshire County Council, to provide for new and better facilities for getting North. The object of the Bill is to enable the Council to purchase from the Gunthorpe Bridge Company an existing bridge over the river Trent, to demolish that structure, and to build a new bridge on a site slightly to the east. The present bridge is described as quite inadequate for modern traffic. The access on each side is also very bad, and the Bill will give the County Council power to improve an existing road and to construct a new road to relieve traffic from Nottingham and that on the Great North Road. The new bridge will improve the navigation of the river, as it will allow several additional feet of headway. The estimated cost of the scheme is £120,000.

NORTH OF ENGLAND.

(From our own Correspondent.)

More Works Closing Down.

THE depression in the iron, steel and allied trades in the North of England is very marked. The first quarter of the year has closed with the hopes of a revival, which were entertained at its advent, still unrealised. It is true anticipations were never extravagant, but still the aspect of the industrial horizon seemed to give promise of better things. Rapidly the prospect has changed, and the outlook is regarded as particularly gloomy. The grave effect of the continued depression is reflected in the fact that two more ironworks are closing down entirely—the Seaton Carew Ironworks and the Thornaby Ironworks. When these stoppages are accomplished, there will be no fewer than seven idle ironworks on the North-East Coast, the others being the Linthorpe Ironworks, the Tees Ironworks, the Lackenby Ironworks, the Weardale Ironworks, and Jarrow (Palmer's) Ironworks, and there will be only 40 blast-furnaces in operation out of a total of 108 in existence, or four fewer furnaces than the number working at the beginning of the year. In the case of the Thornaby Ironworks, it is understood that the coke ovens are also to be put out of action. The firm points out that it cannot go on indefinitely piling up stocks of iron, when there is practically no demand for it owing to the trade depression. It has large stocks of iron in hand; sufficient to last three or four months at the rate the metal is being disposed of under present conditions. This is the second occasion upon which the Thornaby Ironworks have been obliged to close down since the termination of the war, the first being in 1922, when the combine with which the company was associated became involved in financial difficulties. On that occasion the works were shut for about a year. For some time only one furnace out of four has been in operation at the Seaton Carew Ironworks, and the coke ovens were closed down a few weeks ago. The remaining furnace is now being blown out, which will mean the complete cessation of work.

Brighter Shipbuilding Outlook.

The outlook for shipbuilding on the North-East Coast seems to be a little brighter. This week Swan, Hunter and Wigham Richardson, Ld., Wallsend, have received an order from the Ellerman Lines, Ld., for a cargo steamer of 11,400 tons deadweight, to steam 12 knots. The engines will be supplied by the Wallsend Slipway and Engineering Company, Ld. An order has been placed by Brown, Hanson and Co., shipowners, Hull, with the Northumberland Shipbuilding Company, of the Tyne, for the construction of a steamer of 8230 tons for general tramp work. Delivery has to be effected within seven months. It is also understood that the Anglo-Saxon Oil Company, of London, which has been in the market for six vessels, has placed orders for four of the ships with two Tyne firms. Notwithstanding the new work which is being obtained, however, the shipbuilding industry in this area is in a very depressed state, the great majority of the berths in the shipyards being unoccupied. Many orders are required before normal conditions can be restored.

Cleveland Iron Trade.

The Cleveland pig iron trade is still languid. The slight improvement noted last week has proved to be only a flash in the pan, and the market has once more assumed a very quiet appearance. The revival was confined strictly to foundry iron, but some substantial orders were fixed up. Now even the demand for foundry iron has fallen away again, and although makers are in no immediate anxiety about the disposal of their output, the attempt to raise the price has failed. This week no more than 77s. 6d. per ton has been obtainable for No. 3 G.M.B. Cleveland pig iron, and it is possible to shade that figure with a good order. No. 1 has dropped to 82s. 6d., No. 4 foundry to 76s. 6d., and No. 4 forge to 75s. 6d. A great deal hinges on the export position. At present overseas demand is extremely limited, but there is a possibility of developments in this direction which would give a welcome stimulus to the market.

Hematite Pig Iron.

The recent and prospective stoppages of blast-furnaces chiefly relate to the production of hematite. In fact, when the Thornaby Ironworks cease in a week or two there will remain only eleven blast-furnaces on the North-East Coast on hematite iron as compared with fifteen on foundry and thirteen on basic ferro-manganese, &c. The demand however, is no more than sufficient to absorb even this limited output, and mixed numbers are down to 83s., with No. 1 at 83s. 6d. per ton.

Ironmaking Materials.

The foreign ore trade is deadly dull, consumers showing no disposition to renew contracts. Best Rubio ore is nominal at 22s. per ton c.i.f. Tees. The Durham coke makers seem resolved to regard 22s. 6d. per ton as their minimum for good furnace coke, delivered at the works, though consumers are not inclined to offer so much.

Manufactured Iron and Steel.

The prolonged depression in the manufactured iron and steel trade has at last resulted in a cut in prices. Of course, the situation has become easier on account of the fall in the price of pig iron, which reduces manufacturers' costs, but no doubt it is the lack of orders which has prompted steel ship plate manufacturers to cut the price to home buyers to the extent of 7s. 6d. per ton, steel ship plates being now offered at £8 17s. 6d. per ton, delivered at buyers' works. Steel sections are also 7s. 6d. to 10s. per ton cheaper. The fact that continental competition in the steel trade is becoming less keen encourages the hope of an expansion of business here. There have been inquiries on Italian account, but they are regarded as having been put round merely to test the market, the heavy import duty to that country being considered a sufficient barrier to contracts being made. Home trade still falls below what could be desired, but structural steel is in better request.

The Coal Trade.

There are no signs of any immediate lifting of the depression in the Northern coal trade, and fitters of every class of coals are eager for additional business, as although many pits are idle, and output at others reduced, there is still a surplus of coal available, and prices favour buyers. The labour troubles in Sweden are stated to have brighter prospects of a settlement, but at the same time no great hope is expressed on this side that a settlement would be followed by any special demand setting in for coals. German advices state that at all seaports stocks are heavy, while inland immense quantities are stacked. France and Italy are reducing demand to a minimum. April prospects, therefore, are none too cheerful at the moment. Coal prices are about unchanged from last week. The coke trade remains quiet, and with ample stocks, prices are easy. The depression in the market is further emphasised by the ascertainment for December, January and February, which will govern wages in Northumberland in April. Wages on the latest accountancy report would have been 61.36 per cent. on basis rates, as compared with 64.74 per cent. in March, a reduction of 3.38 per cent. The minimum rate is 100 per cent., so that miners' earnings will be more than 38 per cent. above the economic proceeds and costs of the industry.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding.

THE output figure for the month of March would appear to indicate a flourishing state of affairs in the shipbuilding industry. All that can really be said, however, is that the returns show that excellent progress has been made with the work on hand. The amount of new work coming in is far too small to maintain the present rate of activity, and many berths must remain unoccupied. The figures for March are the highest on record, the total being thirty-two vessels of 73,956 tons aggregate. This total is largely accounted for by the launching of two large passenger liners and a somewhat smaller vessel for New Zealand owners. The vessels referred to are as follows:—Transylvania, twin-screw geared turbine, 16,800 tons, for the Anchor Line; Rawalpindi, twin-screw, 16,100 tons, for the P. and O., London; Limerick, twin-screw motor ship, 9000 tons, for the Union Steamship Company of New Zealand. New contracts include four cargo steamers of 7000 tons each, for Glasgow owners; two twin-screw motor vessels for the Argentine Navigation Company; and two steamers for J. and J. Harrison, Liverpool. It has also been reported that two cruisers of 10,000 tons each will be built for the Australian Government, but it is understood that no confirmation of this

order has yet been received. For the first three months of this year the launches on the Clyde total fifty-two vessels of 143,458 tons aggregate.

No Improvement.

Practically nothing of a fresh nature has been reported with regard to the steel, iron and coal trades, and the general situation is most unsatisfactory. The locomotive industry has been brightened by the announcement that a large number of engines have been ordered on behalf of the London, Midland and Scottish Railway, and employment for a considerable number of men is assured. If the order for the two cruisers mentioned above receives confirmation another ray of hope will be provided, and may also help to stimulate allied industries.

Steel and Iron.

In the meantime, the steel and iron trades continue in a most unsatisfactory state. Specifications for steel plates and sections are exceptionally scarce, and the probability of contracts being received is not improved by the offerings of cheaper continental material. Steel sheets are still fairly busy, but a weaker tone is creeping in, even in galvanised varieties. Foreign demands have slackened somewhat, and the home turnover is disappointing. Bar iron is inactive and makers have difficulty in providing work from week to week. Here, again, the continental article offers severe competition. The re-rolled branch of this industry shows a little more stir, but prices are exceptionally keen. Pig iron is dull in the extreme. Outputs have been cut down to a very low minimum, but stocks in makers' yards continue to accumulate, and it is difficult to see how a further curtailment of production can be avoided. Prices continue to weaken.

Coal.

There has been no relaxation of the depression in the coal trade. More pits have been closed down, but supplies are still in excess of requirements. Foreign demands are extremely disappointing, and though some inquiries have come through from Belgium, the quantities involved could have little effect on the general situation. Lanarkshire flints retain a measure of firmness, owing to shipments to West Italy, but practically all other descriptions of round fuel are decidedly weak. Washed nuts are apparently a shade firmer, but this is due more to the reduction in the output of round coal than to extra business. Aggregate shipments amounted to 238,748 tons, against 258,868 tons in the preceding week and 145,545 tons in the same week last year. It has been reported that the Dundee Corporation gasworks has arranged for supplies of fuel amounting to about 100,000 tons, at an average of 5s. 5d. per ton below last year's figure.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Position.

It is satisfactory to be able to record some slight improvement in the general conditions of the steam coal trade, although the improvement is not manifest in higher values. The fact remains that the ready supply of tonnage is better. Whereas it has been customary during the past month or more to find a score or so of idle loading appliances at the various docks in this district the position now is that the number of steamers in dock approximates to the number of berths. This fact means that loading operations are more active, and that collieries are securing the clearance of standing coals quicker, so that there is an improved supply of empty wagons available to keep the pits working. At the same time the general demand is not appreciably brisker, though in some directions there is a tendency towards more activity. It cannot be said that prices have hardened, but there are not so many weak spots for coals for immediate shipment. Doubtlessly the fact that the Easter holidays are within measurable distance is responsible for slightly more activity, and efforts will be made by many exporters to execute their commitments before the vacation rather than wait until after it, when coals may be scarcer, as the chances are that outputs during Easter week will be reduced to about a third of the normal proportions. News is now awaited regarding the placing of the Norwegian State Railways' order for 110,000 tons of best Admiralty large double-screened coals for delivery over five months ending with September. It is reported that local shippers have made a determined bid for this business, and have cut prices to as low as 26s. 6d. f.o.b. As regards the order of the Egyptian State Railways for 150,000 metric tons of Monmouthshire and Cardiff large coals for delivery over May, June and July, it is satisfactory to be able to record that the contract has definitely come to this district. The business has been obtained by Watts, Watts and Co. When tenders went in it was reported that the lowest figure was that of Evans and Reid at 34s. 4d. net c.i.f. Alexandria, while the next was that of Watts, Watts and Co. at 34s. 6d., but it is understood that the former firm made some reservation respecting the period of delivery, which evidently has not been accepted. Now comes the news that the order has gone to Watts, Watts and Co. at 34s. 4½d. c.i.f. Alexandria. The Portuguese Railways are in the market for 10,500 tons of large and a similar quantity of small coals for delivery from the middle of April to the end of June.

Coalfield Items.

Unfortunately the notices tendered by the Blaenavon Company to about 2500 workmen at its pits a fortnight ago matured at the end of last week, and these men are now on the unemployed list. So far as can be ascertained no steps have been taken either by the employers or the workmen's representatives to bring about a continuation or resumption of work. Several hundred miners in the same district are also under notice to terminate their contracts, so that the outlook for this area is very gloomy. Nothing has been heard for quite a long time of non-unionism in the coalfield, until this week. It is now reported that the Council of the No. 1 Rhondda District has decided to tender strike notices throughout the whole district on April 20th. These notices will terminate on May 1st, which is Labour Day, and effect will be given to them unless in the meantime the non-unionists have fallen into line. It is stated that there is absolute determination on this occasion to wipe out non-unionism. If the strike is carried out it will affect 40,000 workmen.

Ship-repairing Industry.

The conditions in the ship-repairing industry of this district have by no means been satisfactory for some time, and unfortunately an order has been lost during the past week or so to a Dutch firm. The steamer in question was the steamship Ino, and it is stated that the Dutch firm put in a tender for the work which was 33⅓ per cent. below the lowest British price. The loss of the order to the Rotterdam firm in question is attributed to the subsidy granted to Dutch firms by the Netherlands Government in conjunction with local corporations. It is understood that Bristol Channel repairers are arranging a meeting to discuss ways and means of opposing continental competition. At the same time a small order has been secured by Mountstuart Dry Docks and Shearmans, Ld., for the repair of the Norwegian steamer Tello, which recently collided with the breakwater at Port Talbot when docking with a cargo of iron ore. The work of repairing the damage will take about a week to carry out. The conditions in the industry, however, are compelling ship-repairing undertakings to effect the strictest economy in operating, and it is reported that the Cardiff Channel Dry Docks and Pontoon Company, one of the largest repairing organisations in this district, is taking steps to centralise its work. With this object the directors have decided to close down the company's Barry workshops. Any work received will be carried out at the works of the Barry Graving Dock and Engineering Company, which is a subsidiary company. It is also understood that as regards the company's subsidiary undertaking at Newport, the Tredegar Dry Docks and Wharf Company, the closing down of this yard is contemplated, in which case the work would be transferred to the Channel Dry Docks at Newport. So far as Barry is concerned, there is no doubt that trade at this port has been very bad all round for some time, and a number of men employed by the Great Western Railway Company, including cranemen, dockgate men, &c., have received notices to terminate their employment.

Vauxhall Experiment.

From all accounts it would appear that the experiment on the part of the miners of the Vauxhall colliery, near Wrexham, is working out satisfactorily, but according to the official report submitted at the annual meeting of the North Wales Miners' Association, the executive committee has recommended to the Council meeting that the Vauxhall lodge should be expelled for a period of three months.

Tin-platers' Wages.

As the result of the consideration given by the sub-committee to the claims put forward by the datal men at the annual meeting of the Joint Industrial Council, quite a large number of workmen in the tin-plate industry will receive benefits. The decision of the sub-committee provides for an advance of 10 per cent. to those previously in receipt of 5s. per day, bringing up their base rate to 5s. 6d. per day. Those in receipt of a rate over 5s. but under 5s. 6d., will be advanced to 5s. 6d. Payment of these increases will apply retrospectively to the first week in January.

Current Business.

The tone of the steam coal market is a shade steadier for prompt loading, as tonnage has come along better and shipments are more active. All weak spots have not been eliminated, and there is still some irregularity, but not to the extent that was the case a week ago. It is expected that the conditions will continue better up to the Easter holidays. The general demand, however, continues to be quiet, and considerably more business is required to give real strength to the market. Anthracite coals are steadier and are likely to improve further during the next few weeks.

Latest News from the Provinces.

THE MIDLANDS AND STAFFORDSHIRE.

Ironworkers' and Miners' Wages.

The wages of ironworkers in the Midlands, which are regulated by the sliding scale under the Midland Iron and Steel Wages Board, will be reduced 2½ per cent. from Monday, April 6th, to Saturday, June 6th. Puddlers' wages will, during this period, be 65 per cent. above the basis rate of 13s. 6d. The ascertainment of wages for Cannock Chase miners, as fixed by the Area Wages Board, shows that the figure for April will be 57.58 above the basis, compared with 57.47 for March. The increase is so slight that the minimum wage for stallmen, which now stands at 10s. 4d. per day, will not be affected.

WALES AND ADJOINING COUNTIES.

Tin-plate Trade.

There is a slightly better outlook for tin-plate workers in the Swansea district, as seven mills have been restarted at the Duffryn Steel and Tin-plate Works, Morriston, Swansea. As a consequence about 300 men have been able to resume employment.

CATALOGUES.

Petters, Limited, Westland Works, Yeovil.—Publication No. 917 on the Petter electric lighting sets.

The Visco Engineering Company, Limited, 162, Grosvenor-road, S.W. 1.—Leaflet of the firm's manufactures.

Harris and Sheldon, Limited, 46, Cannon-street, E.C. 4.—Folder illustrating and describing the Sankey-Sheldon steel cupboard. No. 628.

Bruce Peebles and Co., Limited, Edinburgh.—Pamphlet No. 21 E. containing complete specification of the firm's medium size self-contained continuous-current dynamos and motors.

Metropolitan-Vickers Electrical Company, Limited, Trafford Park, Manchester.—Special publication No. 7720/3, describing the winding engine installation supplied to the Harworth Colliery.

Industrial Combustion Engineers, Limited, Astor House, Aldwych, W.C. 2.—Four illustrated descriptive catalogues on Bailey boiler meters, Bailey fluid meters, Bailey flush front meters, and Bailey indicators.

The Churchill Machine Tool Company, Limited, Broadheath, near Manchester.—Two brochures, one on the manufacture and maintenance of automobiles, the second on the manufacture and maintenance of locomotives.

The English Electric Company, Limited, Queen House, Kingsway, W.C. 2.—Publication No. 225 entitled "Steam Turbines"; publication No. 561 on "English Electric" mixed-pressure turbines; and price list 2111 of Ironclad oil circuit-breaker pillars.

The United Machine Tool Company, Limited, 14, Holborn Hall, Gray's Inn-road, W.C. 1.—Catalogue No. G 501/P on the abridged manufacturing programme of the Associated Works and No. S 501 illustrating and describing the four-in-one universal machine tool.

Hadfields, Limited, East Hecla and Hecla Works, Sheffield.—Two catalogues, one on specialities for dredgers and the other on tramway work specialities. Also three illustrated leaflets: No. 204, on manganese steel lift or step joints; No. 207, on tramcar axles; and No. 206, on Hadfields' Hecla 36 and 109 steels.

The Oil Well Engineering Company, Limited, Cheadle Heath, Stockport.—Set of bulletins describing the various oil-field and general supplies as follows:—B., blocks, tackle, sheaves, hooks, and rope; D., percussion drilling and fishing tools; E., oil well equipment; M., engines and boilers; P., pumping equipment; P P. steam and power pumps; R., rotary drilling equipment; S., rigs and derricks; T., elevator tongs and pipe tools.

British Thomson-Houston Company, Limited, Rugby.—Four publications as follows:—D.L. No. 4471, dealing with B.T.H. systems of protection for alternating-current generators, transformers and feeders; Price List 2251-B, of direct-current motors up to 30 horse-power; D.L. 5021-A and Price Supplement 5021, giving details and prices of alternating-current drum controllers and resistances.

CONTRACTS.

John I. Thornycroft and Co., Ld., have received an order from the Wiltshire County Council for twelve Thornycroft type "BX" 2½-ton hydraulically operated tipping wagons.

Johnson and Phillips, Ld., of Charlton, London, S.E. 7, have just received the following switchgear orders: from the South African Railways for twenty-five draw-out truck type and three stationary cubicles, and from the Union Public Works Department for six draw-out truck type and twenty-one stationary cubicles.

H. R. Marsden, Ld., of Leeds, has recently received the following orders:—From the Inverness Town Council, for stonebreaking, elevating and screening plant, and tar-macadam plant; from the Gordon Quarries, Ld., Hawick, for crushing, elevating and screening plant; and from the Devon County Council, for granulating and screening plant.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

Sir George G. Goodwin, K.C.B., LL.D., R.N. (Retired), has joined the board of J. Samuel White and Co., Ld., shipbuilders and engineers, of East Cowes, Isle of Wight.

Mr. Charles McKinnon, A.M. Inst. C.E., of the Highland Section of the London, Midland and Scottish Railway, has been appointed district engineer of the Sudan Railways and Steamers.

British Ropeway Engineering Company, Ld., asks us to announce that it has changed its address from 34, Fenchurch-street, London, E.C. 3, to 14–18, Holborn, E.C. 1. Telegraphic address, "Boxhauling, Smith, London."

Fuller's United Electric Works, Ld., of Chadwell Heath, Essex, asks us to state that, to cope with increasing business, it has removed its Manchester depôt to larger premises at 19, Chapel Walks, Cross street. Telephone, City 857.

F. L. Smidth and Co., Ld., inform us that they have moved their office from 20, Essex-street, Strand, W.C. 2, to Victoria Station House, Victoria-street, London, S.W. 1. Telegrams: inland, "Chalkiness, Sowest, London;" foreign, "Chalkiness, London." Telephone number, Franklin 6107–8.

The Association of Consulting Engineers—Annual Dinner.—The annual dinner of the Association of Consulting Engineers, which had been postponed from last November owing to the incidence of the General Election, took place at St. Stephen's Club, Westminster, on March 26th. Some 150 members and guests spent a most enjoyable evening. We have remarked on former occasions on the absence of formality from, and the spirit of camaraderie which prevails at, these periodic gatherings and this year's meeting proved to be no exception to the general rule. Everything went with a swing. The menu was excellent and the speeches unusually good. The health of "The King" was drunk at the invitation, of course, of the chairman, Mr. Sidney R. Lowcock. Then the toast of "His Majesty's Ministers" was offered by Mr. A. H. Dykes, the hon. secretary of the Association, and responded to in light vein by Lieut.-Colonel the Right Hon. Wilfrid W. Ashley, the Minister of Transport. Though the Master of the Rolls, owing to family bereavement, could not be present to reply to the toast—always given at these dinners and on the present occasion introduced with characteristic humour by Mr. G. Midgley Taylor—of "The Bench and the Bar," Mr. T. R. Hughes, K.C., the chairman of the Bar Council, stepped nobly into his place and made a really eloquent reply, being ably supported by Sir Lynden Macassey K.C., who also responded. The other toasts were:—"The Association," introduced by Sir John F. Cleverton Snell, and replied to in a witty speech by the chairman; and "The Guests," which was drunk at the call of Mr. A. M. Sillar and acknowledged by Sir George Hume.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	17/6 to 24/-
(1) Spanish	21/-
(1) N. African	21/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	22/-

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	4 11 6	—
No. 1 Foundry	4 10 6	—
No. 3 Foundry	4 8 0	—
N.E. Coast—		
Hematite Mixed Nos.	4 3 0	4 3 0
No. 1	4 3 6	4 3 6
Cleveland—		
No. 1	4 2 6	4 2 6
Silicious Iron	4 2 6	4 2 6
No. 3 G.M.B.	3 17 6	3 17 6
No. 4 Foundry	3 16 6	3 16 6
No. 4 Forge	3 15 6	3 15 6
Mottled	—	—
White	—	—
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 17 6	—
,, ,, Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	3 12 6 to 3 14 0	
,, Forge	3 8 0 to 3 9 0	
(3) Derbyshire—		
No. 3 Foundry	3 17 0 to 3 18 0	
Forge	3 13 0	—
(3) Lincolnshire—		
No. 3 Foundry	4 2 6	—
No. 4 Forge	3 17 6	—
Basic	4 0 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 16 0 (a); 4 18 6 (b); 5 5 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	12 0 0	—
Best ,,	—	—
N.E. Coast—		
Common Bars	12 0 0	—
Lancs.—		
Crown Bars	13 0 0	—
Second Quality Bars	12 0 0	—
Hoops	15 0 0	14 15 0
S. Yorks.—		
Crown Bars	13 0 0	—
Best ,,	13 10 0	—
Hoops	14 10 0	—
Midlands—		
Crown Bars	12 15 0	—
Marked Bars (Staffs.)	15 0 0	—
Nut and Bolt Bars	11 15 0	—
Gas Tube Strip	13 0 0 to 13 2 6	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	13 0 0	—
Ship Plates, ¾in. and up	9 15 0	—
Sections	9 10 0	—
Steel Sheets, 3/16in. to ¾in.	11 0 0	—
Sheets (Gal. Cor. 24 B.G.)	—	£17 0 0

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 17 6	—
Angles	8 12 6	—
Boiler Plates	13 0 0	—
Joists	8 12 6	—
Heavy Rails	9 0 0	—
Fish-plates	13 10 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	9 10 0	—
Soft Billets	8 10 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 15 0†	—
Light ,,	9 0 0 to 9 5 0	
Billets	8 0 0 to 11 0 0†	
Manchester—		
Bars (Round)	9 15 0 to 10 0 0	
,, (others)	9 10 0 to 9 15 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	13 15 0	13 10 0
Plates	9 15 0	—
,, (Lancs. Boiler)	13 0 0	—
Sheffield—		
Siemens Acid Billets	11 10 0	—
Bessemer Billets	13 0 0	—
Hard Basic	9 10 0	—
Intermediate Basic	9 0 0	—
Soft Basic	8 0 0 to 8 5 0	
Hoops	12 0 0	—
Soft Wire Rods	9 10 0 to 11 0 0	
Midlands—		
Small Rolled Bars	8 15 0 to 9 15 0	
Billets and Sheet-bars	7 0 0 to 7 10 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	16 7 6 to 16 10 0	
Angles	8 15 0 to 9 0 0	
Joists	8 15 0 to 9 0 0	
Tees	9 15 0 to 10 0 0	
Bridge and Tank Plates	9 15 0	—
Boiler Plates	13 10 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	22/1½ to 22/6
Block Tin (cash)	235 10 0
,, (three months)	239 5 0
Copper (cash)	60 2 6
,, (three months)	61 5 0
Spanish Lead (cash)	34 17 6
,, (three months)	32 17 6
Spelter (cash)	34 15 0
,, (three months)	33 5 0
Manchester—	
Copper, Best Selected Ingots	64 15 0
,, Electrolytic	65 15 0
,, Strong Sheets	90 0 0
,, Tubes (Basis Price)	0 1 1
Brass Tubes (Basis price)	0 0 11½
,, Condenser	0 1 2
Lead, English	37 10 0
,, Foreign	35 15 0

FERRO ALLOYS.

(*All prices now nominal.*)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/9 per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£24 0 0	8/-
,, 6 p.c. to 8 p.c. ,,	£23 10 0	7/9
,, 8 p.c. to 10 p.c. ,,	£23 0 0	7/6
,, Specially Refined		
,, Max. 2 p.c. carbon	£42 10 0	16/-
,, ,, 1 p.c. ,,	£32 0 0	17/-
,, ,, 0.75 p.c. carbon	£58 0 0	19/-
,, ,, carbon free	1/5 per lb.	
Metallic Chromium	4/- per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 10 0 scale 5/- per unit	
,, ,, 75 p.c.	£20 5 0 scale 6/- per unit	
,, Vanadium	17/- per lb	
,, Molybdenum	7/3 per lb.	
,, Titanium (carbon free)	1/- per lb.	
Nickel (per ton)	£175	
Cobalt	10/3 per lb.	
Aluminium (per ton)	£130	

FUELS.

SCOTLAND.

	Export.
Lanarkshire—	
(f.o.b. Glasgow)—Steam	16/6
,, ,, Ell	17/9
,, ,, Splint	18/9 to 22/-
,, ,, Trebles	15/-
,, ,, Doubles	14/-
,, ,, Singles	13/6
Ayrshire—	
(f.o.b. Ports)—Steam	16/6
,, ,, Splints	18/9
,, ,, Trebles	15/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	14/1½ to 16/3
Screened Navigation	22/3
Trebles	15/3
Doubles	14/6
Singles	13
Lothians—	
(f.o.b. Leith)—Best Steam	16/-
Secondary Steam	15 3
Trebles	16/-
Doubles	14/6
Singles	13/6

ENGLAND.

(8) N.W. Coast—	
Steams	28/-
Household	45/- to 58/4
Coke	28/6
Northumberland—	
Best Steams	17/6 to 18/6
Second Steams	17/- to 17/6
Steam Smalls	10/9
Unscreened	15/6 to 16/6
Household	23/6 to 25/-
Durham—	
Best Gas	19/6 to 20/-
Second	17/- to 17/6
Household	23/6 to 25/-
Foundry Coke	22/- to 23/-

Sheffield—	Inland.	
Best Hand-picked Branch	30/- to 33/-	—
Barnsley Best Silkstone	26/- to 28/-	—
Derbyshire Best Brights	26/- to 31/-	—
,, ,, House	24/- to 26/-	—
,, ,, Large Nuts	20/- to 24/-	—
,, ,, Small	14/- to 16/-	—
Yorkshire Hards	18/- to 22/-	—
Derbyshire ,,	18/6 to 22/-	—
Rough Slacks	10/- to 12/6	—
Nutty ,,	8/6 to 10/-	—
Smalls	4/- to 6/6	—
Blast-furnace Coke (Inland)*	—	—
,, ,, (Export)	f.o.b.	21/3 to 22/3

(9) SOUTH WALES.

Cardiff—	
Steam Coals :	
Best Smokeless Large	26/- to 27/-
Second ,, ,,	25/- to 26/-
Best Dry Large	25/- to 25/6
Ordinary Dry Large	23/6 to 24/6
Best Black Vein Large	24/- to 24/6
Western Valley ,,	23/- to 24/-
Best Eastern Valley Large	23/- to 24/-
Ordinary ,, ,,	22/6 to 23/-
Best Steam Smalls	15/- to 16/3
Ordinary ,,	13/- to 15/-
Washed Nuts	22/- to 28/-
No. 3 Rhondda Large	27/- to 27/6
,, ,, Smalls	17/- to 18/-
No. 2 ,, Large	22/- to 22/6
,, ,, Through	18/- to 20/-
,, ,, Smalls	12/- to 13/6
Foundry Coke (export)	40/- to 47/6
Furnace Coke (export)	25/- to 30/-
Patent Fuel	23/- to 26/6
Pitwood (ex ship)	23/6 to 24/6
Swansea—	
Anthracite Coals :	
Best Big Vein Large	40/- to 45/-
Seconds	35/- to 37/6
Red Vein	29/- to 32/-
Machine-made Cobbles	45/- to 50/-
Nuts	50/- to 55/-
Beans	42/6 to 45/-
Peas	21/- to 23/6
Breaker Duff	9/- to 9/6
Rubbly Culm	11/- to 11/6
Steam Coals :	
Large	22/- to 24/-
Seconds	21/- to 22/-
Smalls	10/- to 13/-
Cargo Through	16/- to 19/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast-furnaces only, 16/9, with fluctuations according to analysis open market, 18/- to 19/- at ovens. † Latest quotations available. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham

French Engineering Notes.

(From our Correspondent in Paris.)

Trade Reforms.

There is so much stagnation in trade that it is impossible to foresee any improvement until manufacturers know what is likely to be the fate of the "reforms" proposed by the Socialist Government. The Senate has made short work of those reforms, and it now remains to be seen what the Chamber of Deupties will do, for it is committed to certain measures which will impose additional burdens on manufacturers and capitalists, and it can only balance the Budget by carrying out the economies suggested by the Senate. Meanwhile, there is no activity, although there would certainly be plenty of work if confidence were restored by an assurance that nothing will be done to interfere with industrial interests. One cause of dissatisfaction is the placing of orders in Germany for railway wagons on account of reparations. This is being discussed in a way that leaves no doubt as to the country's feeling with regard to competition from Germany. The negotiations for a treaty of commerce with that country are dragging along interminably. As the entire production of Alsace and Lorraine is thrown upon the French market, to the serious detriment of certain industries, an arrangement with Germany to facilitate imports is indispensable, but that depends upon a reciprocity which, it is feared, will only leave the way open to competition from Germany in other directions.

Rail Motors.

A paper read before the Société des Ingénieurs Civils by M. Eugène Brillie upon the present development of rail motors, suggested that some progress has been made of late in the application of internal combustion engines to rail motor vehicles, but that a great deal will yet have to be done before the problem is entirely solved. M. Brillie was the designer of the first Paris motor omnibuses and of the Schneider rail motor, which has been in service for nearly two years on a local line in the department of the Orne. After running 30,000 kiloms., the result of the experiment in using a motor-propelled vehicle on a line with particularly severe gradients, was regarded as so far satisfactory that the State Railways ordered ten similar vehicles from Messrs. Schneider et Cie. So many advantages are claimed for the rail motor, such as saving of time and labour and economy of fuel, that the success of this type of vehicle is regarded as depending upon its adaptation to traffic conditions. M. Brillie passed in review all the different types of rail motors, from the ordinary lorry fitted with flanged wheels to the 1200 horse-power vehicles built for Russia, these latter with heavy oil engines and electric transmissions. The great difficulty is the starting torque, which necessitates the employment of a sufficiently flexible transmission between the engine and the driving axle, and it is difficult to obtain that by mechanical means under the required conditions except by more or less complicated devices. It can certainly be provided by clutches with ample frictional surfaces, but that implies inertia of the driven members which interferes with the changing of speeds, and M. Brillie argues that on rail motors the changing of speeds should be as easy as the moving of a throttle lever on a steam locomotive. In a general way, he is of the opinion that mechanical transmissions are suitable for ordinary rail motors, but that when higher powers are reached, something else must be employed, such as hydraulic, compressed air or electric transmissions, and a description was given of a vehicle in which the starting effort is obtained by steam from a boiler, the water being heated by the engine exhaust and by circulation in the cylinder jackets. The engine is of the two-cycle type, and for starting it runs on steam. In England and all over the Continent, the problem has been dealt with in such a way as to have exhausted practically all the systems of propulsion, and while M. Brillie expressed no opinion upon the results obtained, it is evident that most of the experiments have been opening out new departures, which, while not offering a satisfactory solution, may yet lead to better results in the future. So far the only type of vehicle that has given any measure of success is the comparatively low-powered motor with mechanical transmission, and it is probable that developments in design, and the introduction of mechanical devices to meet new requirements, will be followed by an increase of power and a much greater capacity for dealing with traffic. The matter is one of particular interest to France, where every effort is being made to reduce the coal consumption, and locomotives with internal combustion engines are regarded as indispensable for the African colonies. M. Brillie looks to the Diesel engine for the solution of the rail motor problem, and to the use of colonial vegetable oils as a fuel.

Railway Catastrophes.

Three railway accidents during the past week, including one to a goods train, recall the remarkable series of "epidemics" that break out from time to time, and for which there is no explanation. An express train was derailed on a bridge at Saint-Benoit, near Poitiers, and two coaches broke through the parapet and fell into the river Clain, with the loss of several lives. It is declared that a rail broke under the locomotive, the coupling severed, and the two coaches fell over the bridge, leaving the others on the permanent way. Statements have been made to the effect that the line was under repair, but they have not been confirmed, and in any case the driver was not notified. The same evening the Orient Express was derailed on the Est line, fortunately without injury to passengers. In this case a rail had been deliberately removed, and as a goods train had passed thirty-four minutes before, it is clear that expert hands must have been responsible for what might have been a terrible tragedy. Still another curious accident happened to the express from Paris to Bordeaux. While running at a speed of about 50 miles an hour on a straight stretch, the rim of the driving wheel broke. It smashed the connecting-rods, which were cut clean away, and passing up through the tender just behind the driver and fireman, continued its trajectory, falling on the permanent way. The train was stopped without other damage.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

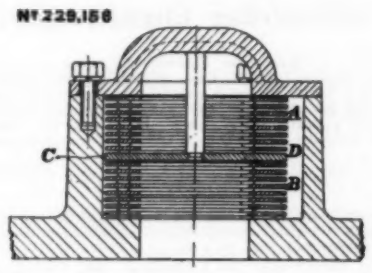
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

SWITCHGEAR.

229,156. May 14th, 1924.—Improvements in and relating to Relief Devices for Electric Switches and the like, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, W.C. 2; and Charles Thomas Hams, of Dunchurch-road, Hillmorton Paddox, Rugby.

The relief device described in this specification consists of two or more groups of spaced washers A and B arranged as illustrated so that the hot gases due to an explosion pass through the

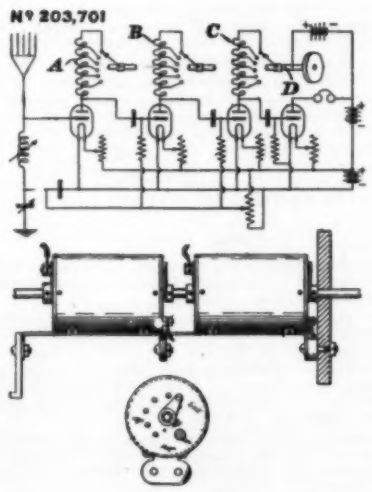


two groups of washers in series, and in doing so impinge upon the cooling surface. The housing in which the two groups of washers are placed may form an integral part of the switch casing or it may be attached to it. The object of the baffle plate C is to divert the hot gases or flames through the lower group of washers in an outward direction and then through the space D towards the upper group of washers, through which the products of combustion escape in an inward direction.—*February 19th*, 1925.

TELEGRAPHS AND TELEPHONES.

203,701. September 6th, 1923.—Improvements in Apparatus for Use with Radio Frequency Amplifiers, *The Dubilier Condenser Company, Ld., of Duncan Works, Goldhawk-road, Shepherd's Bush, W.* 12.

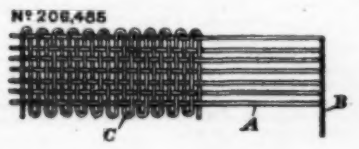
One of the objects of the present invention is to provide a multi-stage radio frequency amplifier, which is adapted for operation on a broad band of wave lengths, and which may be quickly adjusted for amplifying signals of widely different wave lengths. One of the receiving circuits given in the specification is reproduced. The main connections will be understood from



the diagram and do not call for description. The invention consists in the provision of variable inductances A B C, that are varied by a common adjustable shaft, which controls three switches as shown. It is obvious that with this arrangement all the inductances are varied simultaneously, thereby rendering the circuit quickly adjustable for reception on widely different wave lengths. The actual construction of the variable inductances is shown in the lower drawing, which, however, only shows two instead of three inductances as in the particular circuit illustrated.—*February 6th*, 1925.

206,485. November 3rd, 1922.—Improvements in Electrostatic Shielding Material, *Marconi's Wireless Telegraph Company, Ld., of Marconi House, Strand, W.C.* 2.

This invention relates to an arrangement for preventing

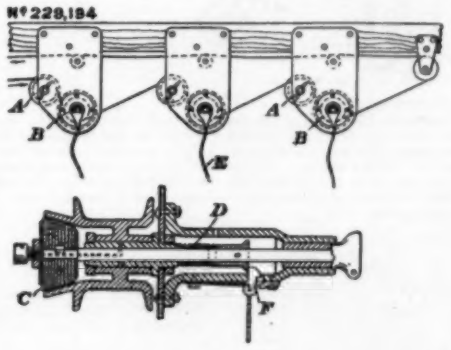


undesired electrostatic or capacity coupling between electrical devices. A shield is made from a number of conductors which form a substantially good conducting surface which is therefore a substantially equipotential surface. The illustration shows a shield in the form of an elongated woven strip or tape of fabric comprising a number of parallel conductors A, which are preferably closely spaced and of small diameter. These conductors are usually insulated from each other throughout their length and are connected to earth at one point by means of an earthing conductor B soldered to each of the conductors of the strip. The warp threads A of the fabric are made of fine copper wires and the woof threads C are made of cotton or other insulating thread. Several modified forms of construction are described and there is a number of illustrations showing applications of the invention.—*February 11th*, 1925.

TRANSMISSION OF POWER.

229,194. July 25th, 1924.—Means for Driving a Group of Small Machines, L. McLachlan, Longreach, Queensland.

This arrangement is primarily intended for driving sheep-shearing machines, but might be used for any group of light appliances. The driving belt runs round jockey pulleys A A and driving pulleys B B. The jockey pulleys are mounted in slots in the plate hangers, so that they can be moved to adjust

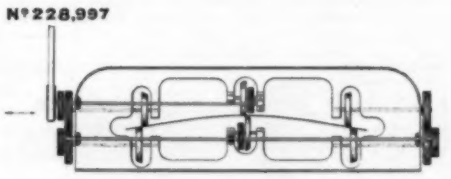


the tension of the belt. The driving pulleys run in fixed bushes and are connected with their spindles by means of friction clutches C, which are held in engagement by the spring D. The spindle is connected with the machine to be driven by means of flexible shafting E. When it is desired to stop the machine the spindle is pushed in by hand to disengage the clutch and it is held thus by the trip catch F.—*February 19th*, 1925.

MACHINE TOOLS AND SHOP APPLIANCES.

228,997. November 15th, 1923.—Plate Shears, H. S. Thomas, Hazlewood, Cardiff-road, Llandaff, Glamorgan; and W. R. Davies, Forest-Lyn, Church-road, Whitchurch, Glamorgan.

This machine is intended to take the place of crocodile shears

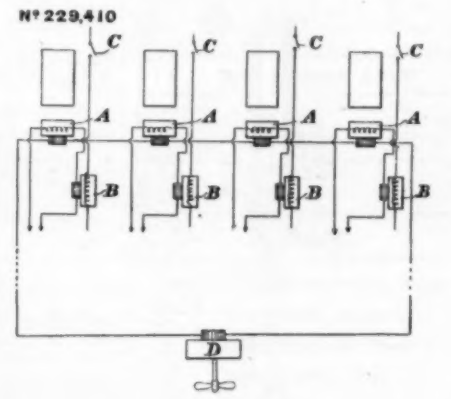


for trimming the black plates, made subsequently into tin-plates. The black plates assume an arched shape in cooling and the inventors consequently use disc shears set at different levels, as shown in the drawing, so as to accommodate the bent plates.—*February 16th*, 1925.

SHIPS AND BOATS.

229,410. November 27th, 1923.—Improvements in and relating to Systems of Electric Ship Propulsion, The British Thomson-Houston Company, of Crown House, W.C. 2, and Dennis Ernest Jewett, of Sunnybank, Old Bilton, near Rugby.

This invention relates to systems of electric ship propulsion, and more particularly of the kind in which a number of direct-current generators, each driven by a separate prime mover, are connected in series to supply current to one or more propeller motors D. The object of the invention is to provide a

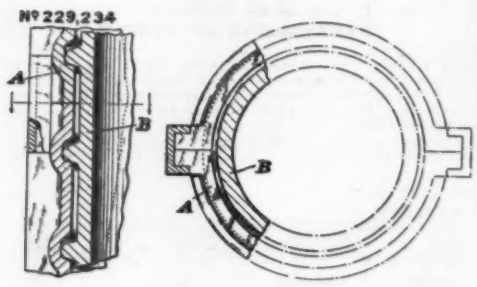


simple arrangement for automatically reducing the excitation of each generator in accordance with a reduction in speed of its corresponding prime mover, so that the torque exerted by the generator is reduced to a sufficient degree to permit of the prime mover accommodating itself at the reduced speed until it is able to pick up its original speed and torque. From the diagram it will be seen that the series-connected generators A are provided with boosters B in series with the main field windings of the generators. The fields of the boosters are arranged to be controlled automatically by switches C, actuated by the governors of the prime movers.—*February 26th*, 1925.

BUILDING.

229,234. November 8th, 1923.—Piles, A. G. Rotinoff, Regent House, Kingsway, London, W.C. 2.

This invention is intended primarily to permit the use of hollow concrete piles of such a light section that they would not otherwise withstand the impact of the blows necessary for their driving into the ground. The hollow pile A is thus provided with an internal screw thread, with which a thread on a driving mandrel



B engages. The pitch of the thread is such that during the process of driving there is no tendency for the mutual rotation of the two parts, but when the pile is driven, the mandrel can be screwed out by a rotary action. The screw thread naturally distributes the impact of driving throughout the length of the pile. The pile itself may be made in two halves as indicated in the plan view.—*February 9th*, 1925.

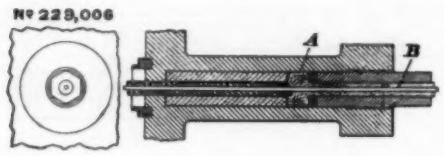
MISCELLANEOUS.

219,703. July 25th, 1924.—Improvements in Electric Frequency Transformers and Choke Coils, Telefunken Gesellschaft für drahtlose Telegraphie m.b.H., of 12-13, Hallesches Ufer, Berlin, G rmany.

This invention relates to electric frequency transformers and choke coils. It has before been proposed to subdivide the iron cores of frequency transformers and choke coils with the object of avoiding internal losses. According to this invention, frequency transformers and choke coils are made with cores formed of ferro-magnetic metal in colloidal form, so that the core is in an extremely fine state of subdivision. The colloidal metal is preferably enclosed in a porcelain vessel and the coil is wound on this vessel. To obtain a closed magnetic core the inventors fill a tubular vessel closed on itself with colloidal metal. The colloidal metal may be obtained in several known ways: for example, by means of an electric arc under water, and when so made the suspension of the colloidal metal in the water is used.—*February 19th*, 1925.

229,006. November 16th, 1923.—Improvements in Stuffing-boxes in connection with Cable Manufacture, The Western Electric Company, of Connaught House, Aldwych, London, W.C. 2; and William Stuart Gorton, of 62, Rotherwick-road, London, N.W. 11.

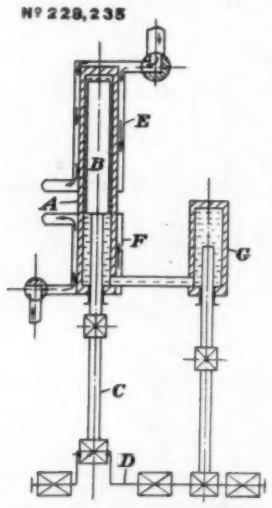
This invention deals with the testing of submarine cables under hydrostatic pressure, and more particularly with an improved



form of stuffing-box for use in this connection. A hard rubber or ebonite plug A is inserted between a soft rubber packing on the left and a hollow compression nut on the right. With this arrangement outward flow of the gutta percha is effectively prevented. Where the conductor passes through the hollow compression nut it is insulated from the nut by a tube B. Several modifications of the invention are described.—*February 16th*, 1925.

229,235. November 17th, 1923.—Heat Engines, W. Anderson, 15, Verdun-avenue, Hebburn; and W. Brown, 3, West View, Durham-road, Lanchester, Durham.

This invention relates to heat engines and consists in the arrangement of a vessel in which the working medium is alternately displaced by a displacer from one end to the other of the



vessel, the ends of the vessel being maintained at a difference of temperature. The medium is a fluid with a high critical temperature, in order that it may be retained as a liquid at a high temperature when necessary, for example, water, mercury, oils, or the like. The displacing of the medium towards the cold end of the vessel is done at a relatively low pressure and the change in volume due to the contraction of the medium and the expansion or dilation of the vessel caused by the transference of heat from the former to the latter and the rejecting of heat in the cooler is taken up by the moving in of the engine ram, thus keeping the pressure approximately constant. The displacing of the medium towards the hot end of the vessel is done at a higher pressure, and the resulting change in volume caused by the transference back of the heat to the medium from the vessel, and the adding of additional heat from an external source is taken up by the moving out of the engine ram, again keeping the pressure approximately constant. The difference between the work expended on the engine ram in forcing it in, in the first case, and the work done by the engine ram when moving out, in the second case, is the useful work available, excepting the surplus obtained from the pressure changer as mentioned subsequently. The pressure of the medium is changed at or about the end of each stroke of the engine ram by means of another ram driven by mechanical means from the engine ram. The cycle consists of four stages as follows:—(1) Compression, (2) heating at approximately constant pressure, (3) expansion, (4) cooling at approximately constant pressure. In the drawing A is the working chamber, B the displacer with its connecting-rod C and crank shaft D, E is the heating jacket, and F that for cooling. G is the pressure changer, driven off the crank shaft. The specification includes a detailed explanation of the thermal cycle of the engine.—*February 17th*, 1925.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

TO-DAY.

Institution of Naval Architects.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Annual meetings. For programme see page 336. 11 a.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Lecturette, "Engineering Contracts," by Mr. G. W. Tookey. 7.30 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, Piccadilly, London, W. 1. Discourse, "The Productivity of English Land," by Sir Daniel Hall. 9 p.m.

TO-DAY AND SATURDAY, APRIL 4TH.

Marine and Small Craft Exhibition and Congress.—Royal Agricultural Hall, Islington, London, N. 1. 11 a.m. each day.

SATURDAY, APRIL 4TH.

Institute of British Foundrymen: Lancashire Branch.—College of Technology, Manchester. Annual general meeting. Paper, "The Microscope as a Foundry Adjunct," by Mr. J. S. G. Primrose. 3 p.m.

MONDAY, APRIL 6TH.

Institute of Transport.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2. "The Lessons of the Indian Flight," by Air Vice-Marshal Sir W. Sefton-Brancker and Mr. Alan Chobham. 5.30 p.m.

Institution of Automobile Engineers.—The College, Loughborough. Loughborough Graduates' meeting. Lecture by Dr. W. R. Ormandy, President of the Institution. 7 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. General meeting of members. 5 p.m.

Society of Engineers.—Geological Society's Rooms, Burlington House, Piccadilly, London, W. 1. Paper, "Problems in Designing and Constructing Sea Defence Works," by Mr. E. R. Matthews. 5.30 p.m.

Surveyors' Institution.—12, Great George-street, Westminster, London, S.W. 1. Paper, "The Law of Evidence," by Lieutenant-Colonel H. F. Bidder. 8 p.m.

TUESDAY, APRIL 7TH.

Institute of British Foundrymen: Lancashire Branch, Burnley Section.—Municipal College, Ormerod-road, Burnley. Annual general meeting. 7.15 p.m.

Institution of Automobile Engineers: Coventry Centre.—Broadgate Café, Coventry. Paper, "Brakes for Motor Vehicles," by Mr. G. W. Watson. 7.15 p.m.

Institution of Electrical Engineers: Scottish Centre.—207, Bath-street, Glasgow. Paper, "The Economic Aspect of the Utilisation of Permanent Magnets in Electrical Apparatus," by Mr. E. A. Watson. 7.30 p.m.

Institution of Engineers and Shipbuilders in Scotland.—39, Elmbank-crescent, Glasgow. Paper, "Canadian Bulk Cargo Vessels on the Great Lakes," by Messrs. W. I. Hay and Duncan McArthur. 7.30 p.m.

Institution of Petroleum Technologists.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "Vapour Pressures of Binary and Ternary Fuel Mixtures," by Mr. J. S. Lewis. 5.30 p.m.

West Yorkshire Metallurgical Society.—The George Hotel, Huddersfield. Discussion on "The Selection of Iron by Fracture and Chemical Analysis." 7.30 p.m.

WEDNESDAY, APRIL 8TH.

Institution of Automobile Engineers: Wolverhampton Centre.—Engineering and Scientific Club, Queen-street, Wolverhampton. Paper, "Brakes for Motor Vehicles," by Mr. G. W. Watson. 7.30 p.m.

Radio Society of Great Britain.—Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2. Informal meeting. "Home-made Wireless Components and Sets," by Mr. E. G. Atkinson. 6 p.m.

WEDNESDAY, APRIL 15TH.

Institution of Automobile Engineers.—Chamber of Commerce, New-street, Birmingham. Birmingham Graduates' meeting. Paper, "High-speed Motor-cycle Engine Valve Gears," by Mr. A. Weatherstone. 7.30 p.m.

THURSDAY, APRIL 16TH.

Institute of Metals: London Local Section.—Institute of Marine Engineers, 85/88, The Minories, Tower Hill, London, E. 1. Paper, "Metals in the Gaseous State," by Mr. C. H. M. Jenkins. 7.30 p.m.

FRIDAY, APRIL 17TH.

Diesel Engine Users' Association.—The Engineers' Club, Coventry-street, London, W. 1. Paper, "Recent Oil-engine Developments," by Mr. J. L. Chaloner. 3.30 p.m.

Junior Institution of Engineers.—39, Victoria-street, Westminster, London, S.W. 1. Paper, "Vertical Retorts," by Mr. W. T. Dunn. 7.30 p.m.

SATURDAY, APRIL 18TH.

Institute of British Foundrymen: Lancashire Branch, Junior Section.—College of Technology, Manchester. Lecture on "Foundry Materials," by Mr. A. Hill. 7 p.m.

MONDAY, APRIL 20TH.

Institution of Automobile Engineers: Birmingham Centre.—Chamber of Commerce, New-street, Birmingham. Paper, "Brakes for Motor Vehicles," by Mr. G. W. Watson. 7 p.m.

TUESDAY, APRIL 21ST.

Institution of Automobile Engineers.—The Broadgate Café, Coventry. Coventry Graduates' meeting. Paper, "Designing Rear Axles for Production," by Mr. C. Burrows. 7.15 p.m.

WEDNESDAY, APRIL 22ND.

Institution of Automobile Engineers: North of England Centre.—Milton Hall, 244, Deansgate, Manchester. Paper, "Brakes for Motor Vehicles," by Mr. G. W. Watson. 6.30 p.m.

THURSDAY, APRIL 23RD.

Institution of Automobile Engineers.—Watergate House, Adelphi, London, W.C. 2. London Graduates' meeting. Lecture, "Modern Machine Tool Methods," by Messrs. Buck and Hickman. 7.30 p.m.

Institution of Automobile Engineers.—Training School of Vauxhall Motors, Ld., Luton. Luton Graduates' meeting. Paper, "Supercharging," by Mr. P. H. Goffey. 7.30 p.m.

FRIDAY, APRIL 24TH.

Institute of Metals: Sheffield Local Section.—Mappin Hall, Department of Applied Science, The University, St. George's-square, Sheffield. Paper, "Chromium Plating," by Mr. Byron Carr. 7.30 p.m.

Institute of Metals: Swansea Local Section.—Metallurgical Department of the University College, Singleton Park, Swansea. Annual general meeting. 7.15 p.m.

MONDAY, APRIL 27TH.

Institution of Automobile Engineers: Scottish Centre.—Royal Technical College, Glasgow. Paper, "The Accessibility of the Pleasure Car Chassis," by Mr. M. Platt. 7.30 p.m.

TUESDAY, APRIL 28TH.

Institute of Metals: North-East Coast Local Section.—Electrical Engineering Theatre, Armstrong College, Newcastle-on-Tyne. Annual general meeting. 7.30 p.m.

Institution of Automobile Engineers.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Paper, "The Accessibility of the Pleasure Car Chassis," by Mr. M. Platt. 7 p.m.

LAUNCHES AND TRIAL TRIPS.

Ingola, steel screw steamer; built by Wm. Gray and Co., Ld., to the order of Maclay and McIntyre, Ld.; dimensions, 364ft. by 50ft. by 27ft. Engines, triple-expansion, 25in., 40½in., 67in. by 45in. stroke; constructed by the builders trial trip, March 6th.

Port Hobart, No. 1257, motor ship meat carrier; built by Swan, Hunter and Wigham Richardson, Ld., to the order of the Commonwealth and Dominion Line, Ld.; dimensions, 465ft. by 59ft. 6in. by 43ft. 9in.; 10,800 tons deadweight. Engines, two sets of four-cylinder, two-stroke cycle, solid injection, opposed piston Diesel; constructed by the builders; launch, March 10th.

Hebburn, steel screw cargo steamer; built by the Blyth Shipbuilding and Dry Docks Company, Ld., to the order of Huddart, Parker, Ld.; dimensions, 383ft. 6in. by 51ft. by 26ft. 9in.; to carry 6500 tons. Engines, triple-expansion, 24in., 39in., 65in. by 45in. stroke; constructed by the North-Eastern Marine Engineering Company, Ld.; trial trip, March 11th.

Roi Albert, single-screw steamer; built by Swan, Hunter and Wigham Richardson, Ld., to the order of L. Dens and Co.; dimensions, 315ft. by 45ft. by 30ft. 9½in.; to carry 4660 tons. Engines, inverted, direct-acting, triple-expansion; constructed by the Wallsend Slipway and Engineering Co., Ld.; launch, March 11th.

Cathay, twin-screw mail and passenger steamer; built by Barclay, Curle and Co., Ld., to the order of the Peninsular and Oriental Steam Navigation Company; dimensions, 545ft. by 70ft. by 46ft.; 15,000 gross tonnage. Engines, twin-screw, quadruple-expansion, pressure 220 lb.; constructed by the builders; trial trip, March 12th.

Port Dunedin, motor vessel; built by Workman, Clark and Co., Ld., to the order of the Commonwealth and Dominion Line; dimensions, 465ft. long; 10,000 tons deadweight. Engines, two sets of four-cylinder, two-stroke cycle, solid injection Doxford, opposed piston Diesel; constructed by the builders; launch, March 12th.

Queerimba, steamer; built by William Gray and Co., Ld., to the order of the British India Steam Navigation Company, Ld.; dimensions, 502ft. by 60ft. 9in. by 32ft. 9in. Engines, balanced quadruple, 28½in., 41in., 58½in. and 85in. by 54in. stroke, pressure 225 lb.; constructed by the builders; trial trip, March 12th.

Patrick Stewart, cable steamer; built by William Simons and Co., Ld., to the order of the Indian Government Telegraph Service. Engines, triple-expansion, surface condensing; constructed by the builders; launch, March 13th.

Sir Thomas Price, twin-screw self-propelling hopper bucket dredger; built by Lobnitz and Co., Ld., to the order of the South African Railways and Harbours Administration; trial trip, recently.

Judge Kenefick, steamer; built by Earle's Shipbuilding and Engineering Company, Ld., to the order of the Eastern Steamship Company, Ld.; dimensions, 258ft. by 44ft. by 20ft.; 2510 tons deadweight. Engines, triple-expansion, surface-condensing, 17in., 28in., 46in., by 33in. stroke, pressure 180 lb.; constructed by the builders; trial trip, March 19th.